# Third Report From the Laguna Marine Laboratory

## and Contributions From the Department of Zoology Pomona College

# THIRD REPORT FROM THE LAGUNA MARINE LABORATORY AND THE DEPARTMENT OF ZOOLOGY OF POMONA COLLEGE

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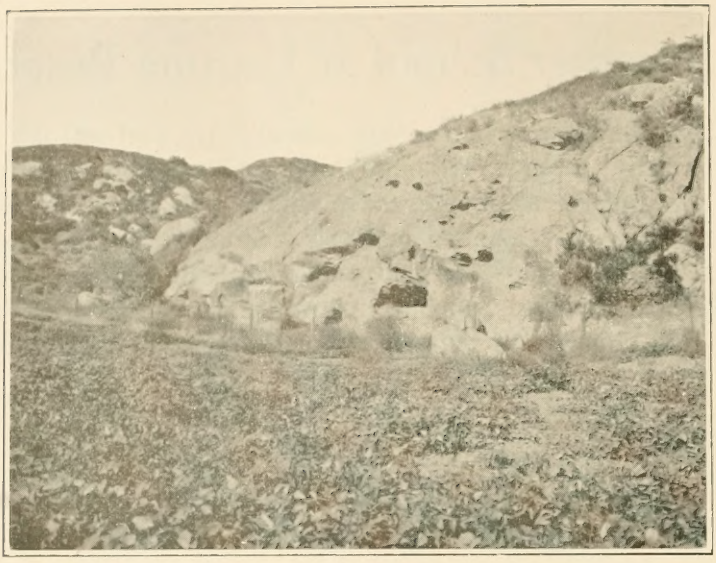
# INDEX

# Summer School at Laguna Beach

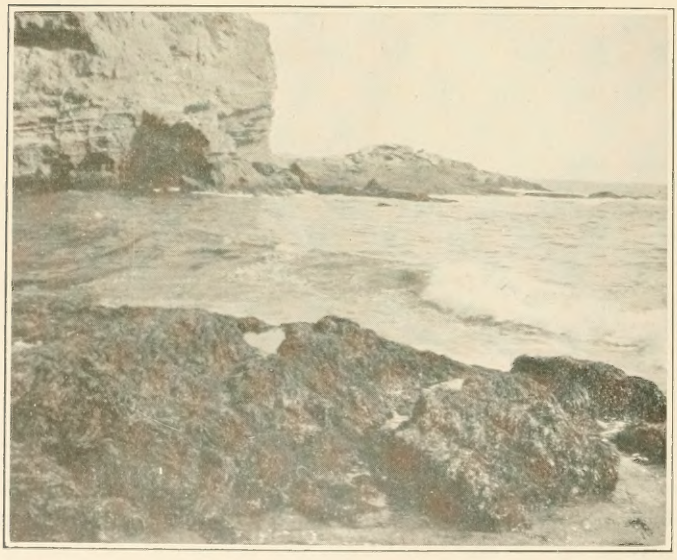
During the six weeks of summer school of the past season (1914) there were in attendance about thirty students and investigators, some of whom remained until the middle of September. In addition to these there were several hundred visitors to the aquarium and laboratory, in spite of the bad condition of the roads. After the middle of the summer running salt water was piped to the laboratories and aquaria, so that it was much easier to keep specimens

LAGUNA LABORATORY

alive. Yet even before this many interesting forms were on exhibition. At all times there were numerous marine animals for study, as well as many living land species, such as tarantulas, lizards, frogs, a large turtle and a number of snakes. Several rattlesnakes were kept in a box in the front of the building until the end of the summer. Several of the largest rattlesnakes were an unending source



IN LAGUNA CANYON



SHORE NEAR SEAL ROCKS

of interest. One day several people were able to observe a king snake swallow a slightly smaller rattler.

From day to day a varied display of marine forms was to be found in the aquarium; at different times rare and curious fish, starfish, sea urchins and devilfish, while now and then some of the larger specimens, such as sharks and rays, were brought in. Some

A COVE ABOVE LAGUNA

of these were kept alive in the large cement floor tank or in the larger jars. Great quantities of smaller specimens were no less interesting, such as sea spiders, serpent stars of many beautiful colors and markings, brilliant nudibranchs, large abalones, curious small crabs and, in fact, all the interesting or beautiful specimens that could be found.

A VIEW FROM ONE OF THE SHORE CAVES

SEAL ROCKS IN THE DISTANCE

Each week, until September, the public was also invited to attend the evening lectures. These were usually of a general nature relating to the life of the sea, but some told of land forms as well, and one was on the Hopi Indian Snake Dance.

The chief work of the laboratory during the first six weeks was in connection with the Summer School. There was a class of nine in General Biology, twelve in General Zoology, and five in General

SHORE NEAR EMERALD BAY

Entomology. There were, in addition, from six to twelve doing special work for a longer or shorter period. Students from three Pacific coast colleges were in attendance, although most of the students and advanced workers were from Pomona College. Two or three studied special Histological or Embryological topics, but the majority were interested in faunal and distributional problems. As announced at an earlier time, the Laguna station is but an extension

of the Biological part of Pomona College, and the plan for special work includes a survey of the whole region from the mountains to the sea. With this in mind, many explorations have been begun, and the aid of specialists in various fields is sought, so that we may first of all know the living forms that inhabit this varied and interesting section of California. We hope that a better knowledge of the species in the different groups here may lead to more extensive observations both by advanced students from the College and by others.

THREE ARCHES BELOW LAGUNA

Together with the special and general work of the students, collections of marine and land animals were obtained all through the summer. Some of these were for the local collection, others to aid in the work of the survey. Among the collections made were many species of sponges, hydroids, polyzoans, pycnogonids, marine worms, Crustacea of several groups and, in fact, nearly all the shore forms that could be obtained between tides or a short distance from shore with a small boat. There were also extensive collections of insects and spiders from the hills and from up and down the coast.

For the study of marine and land animals Laguna has proved itself once more well adapted to our uses. The high hills come down near the ocean at several points, and there are miles of interesting and varied coast line in both directions from the laboratory. All summer, students in small or larger parties tramped over the hills and through the many interesting canyons to the lakes, to the Mission of San Juan Capistrano, or to Balboa and the mud flats. Saturday was the regular field day, and the longer tramping trips

SAN JUAN CAPISTRANO

were then taken, but very often of an evening groups of students enjoyed beach suppers or picnics in some canyon or up in the hills.

That Laguna and its surroundings is a region of great interest and beauty is evinced by the fact that a number of artists make it their home, while it is visited by many others. The trail to Balboa, along the beach or the cliffs, is wonderfully varied and beautiful,

while the drive from Laguna to San Juan Capistrano, except for the lack of villages and ruins, might well be considered a part of the famous Amalfi Sorrento drive in Italy.

During the summer of 1915 courses in general as well as special zoology will be given. General entomology may also be studied with advantage. For those who are just beginning biological work there may be special exercises arranged, as last summer.

There are eight private rooms in the laboratory for special workers. Some of these will be available for investigators who may wish to follow out problems of their own or those suggested by the work of the station. Write

W. A. Hilton, *Director,*
Pomona College, Claremont, California.

# The Central Nervous System of the Pycnogonid *Lecythorhynchus*

WILLIAM A. HILTON

During the summer of 1914 the pycnogonid *Lecythorhynchus marginatus* Cole was found abundantly at Laguna Beach and the results of a general study of the central nervous system are given at this time.

The small size of the animals made sectioning methods necessary from the start. Because of the hard exoskeleton, great difficulty was experienced in preparing slides, and a number of specimens were cut before complete series were obtained. Nothing in the fixation seemed to greatly help, but certain individuals seemed to have softer cuticle.

There are six chief ganglia forming the central nervous system of the adult. The more cephalic centers are a little smaller than the others.

Five ganglia are described by Dohrn '81 and others, due no doubt to a more definite fusion of certain centers. In the embryo of *Palene,* as described by Morgan '91, there are ganglia corresponding to each of the pairs of appendages, those of the seventh or last pair and the abdominal ganglia appear last in development.

Merton '07 describes six pairs of ganglia in *Nymphon parasiticum,* the second pair, or the first subesophageal center, is clearly shown to be composed of two parts on each side, but the last pair represents the abdominal ganglia, if one may judge from the figure given.

In *L. marginatus* the first three cephalic ganglia are quite close to each other and partly fused, as the figure shows. The last three ganglia are more widely separated. From one to two abdominal ganglia are described in other pycnogonids. In this species the abdomen is very small and no ganglia were found. Probably all of the abdominal elements are fused with the last thoracic ganglion.

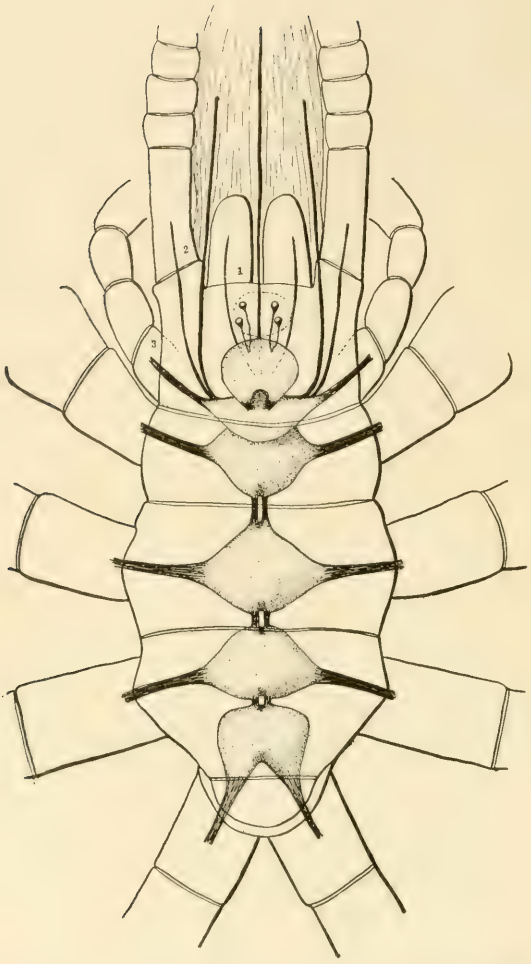



Diagram of the position of the nervous system of *Lecythorhynchus marginatus*, compiled from longitudinal and cross sections. Slightly diagramatic. X50. 1, 2 and 3, first, second and third appendages.

The supraesophageal ganglion is of rather small size. It sends small nerves to the eyes, to the first pair of appendages or chelifori and a mid-ventral branch to the proboscis.

The subesophageal ganglion supplies the other cephalic appendages. There are three branches from each side of this ganglion, one pair is for the proboscis, one for the palpi, or second appendages, and one pair for the ovigers, or third appendages. The second and third appendages are spoken of by some authors as being supplied by distinct ganglia. In this species there is no division into two centers.

The chief branches of all of the other ganglia are to the four larger appendages, or walking legs.

## IMPORTANT LITERATURE

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A contribution to the embryology and phylogeny of pycnogonids. Stud. Biol. Lab. Johns Hopkins Univ., vol. v.

*(Contribution from the Zoological Laboratory of Pomona College.)*

# The Distribution of Collembola in the Claremont-Laguna Region of California

GERTRUDE AULD BACON

## GENERAL HABITS

The Collembola, although minute in size, are very common, being found in almost every condition where there is moisture and some decaying vegetable matter. Moisture seems to be essential to their existence. They are common under rocks, bark of trees, under leaves, in rotten logs, and in moss. Some species collect in great numbers on the surface of standing water, and others, the snow-fleas, appear in crowds so dense as to cover the snow. Some have been found in houses, in ant nests and in the gills of mushrooms. Some species, as *Entomobrya laguna,* are found only on the undersides of rocks in the ocean. They do not generally penetrate deeply into the soil, usually being found on the surface and seldom deeper than three inches. The soil must be of a loose, open texture. They seem to avoid the light and are timid and retiring. Very few of them are solitary and several species may be found together. The complex forms are very lively in their movements and are hard to catch but the simple forms that lack the spring are more sluggish. Some species require more moisture than others and so appear at different times, but most of the species may be found the year around providing there is plenty of moisture.

There is very little exact knowledge about the food of the Collembola, but an examination of the stomach contents seems to show that they feed upon decaying vegetable matter. Very little has been written on the feeding habits. Dr. Fitch observed that the front legs were often used to crowd the food into the mouth. Folsom (1899) states that possibly the food is moistened with saliva before being eaten and then the food

is pulled into the mouth by the retraction of the mandibles assisted by the upper and lower lips, the coarse food being crushed by the ventral teeth of the mandibles.

Except in the canyons, the best collecting time in Southern California is in the winter, due to the absence of rain in the summer. The Collembola do not exist here in as great abundance as reported from other places, because of the dry climate. The only ones I have found in any great number were a species of *Achorutes* found in a flume in an orange orchard after a hard rain. They were several inches deep in this flume and would have filled several gallon pails. Also all the rotten oranges in the orchards were blue with this species. They were also found in great numbers on pools in a newly ploughed field after a hard rain.

## ECONOMIC IMPORTANCE

Until recently, the Collembola were not considered of much economic importance and very little attention was given to them, due no doubt to their minute size and their seeming insignificance. Most authorities considered that they were followers of decay rather than the primary causes of it, that their jaws were too weak to enable them to masticate a root or leaf and that they didn't attack a plant until some other insect had first inflicted an injury. During the last few years, however, this problem has been investigated and it has been found that the Collembola do cause injury to plants, and often serious injury. References in the literature are very few, but among the earlier ones we find that Mr. Curtis in his work on farm insects says, "In Nova Scotia the crops of turnips and cabbages are principally destroyed whilst in the seed-leaf by some *Smynthurus*, the size of a pin's head and nearly globular. It hops with great facility and may be found on every square inch of old cultivated land, but it is not plentiful on new land."

Dr. Asa Fitch says, "Our gardeners universally regard these fleas as being injurious but not so severely injurious as the larger-sized flea-beetles, with which they are almost always

associated." He investigated this subject and came to the conclusion that the Collembola never attack a perfectly green and healthy plant. Of the species *Smynthurus arvalis*, Fitch says, "It is common to see them in the garden, upon the leaves, particularly of the pie rhubarb, where these leaves are perforated with holes by the flea beetles." Guthrie states that he had never met with any gardeners of the State of Minnesota who had noticed any damage from these insects and he himself had ever seen them feeding upon green plants. Guthrie also states that he learned from Prof. H. E. Summers, State Entomologist of Iowa, that a certain species of *Achorutes* kept the soil so stirred up that the young plants couldn't take root and many of them died. Collinge mentions a similar case that came under his notice in which a bed of sweet peas was destroyed.

During the last few years the men who have worked the most on this subject were Carpenter, Evans, Theobald and Collinge of England and Scotland. Carpenter has recorded *Achorutes longispinus* Tullb. and *Lipura ambulans* Linn. as causing injury to bean seeds. Theobald speaks of certain Collembola attacking orchids and others damaging hops. Also he records a species of *Isotoma* which tormented fowls. Marlatt describes a species of *Lepidocyrtus* which infested the houses in Washington, D. C. Collinge has carried on some very careful observations which have established without a doubt that Collembola are distinctly injurious to orchids, beans, peas and numerous bulbs of which the hyacinth, narcissus and tulip suffered the worst. In speaking of the nature of the injury he says, "It is practically the same in all cases, and consists in scraping away the epidermis and then the softer tissue until a distinct hole or depression is formed. After this stage, decomposition of the plant tissues rapidly takes place, due to the inroads of fungi and the bulb is practically ruined."

Collinge also records an instance where the Collembola have damaged pine trees. The opening buds of some shoots of *Pinus sylvestris* were found to be falling off and the young needles had a dry, withered appearance and many of them fell

off when handled. It was found on examination that in the damaged buds there were several Collembola of the species *Seira nigromaculata* Lubb. He found that the insect was attracted by the resinous gum and as soon as the bud opened it made its way to the base of the young leaves and commenced to bite them.

I had some specimens of *Aphorura inermis* sent to me which were found inflicting damage to tender roots of young plants near Santa Barbara. This is the only instance of injury that has come to my notice here in California. In all the orange groves in and around Claremont this year (1914) the rotten oranges were covered with Collembola of the genus *Achorutes* but in no case were they found attacking the good fruit.

## DISTRIBUTION

Insects are among the most widely distributed of the animal groups and the Collembola are among the most widely distributed of these. This is due to the fact that they are not specialized in regard to their food, feeding on small particles of organic matter; that moisture is important to their existence; that they are tolerant of extremes in temperature; and that these simple conditions can be found almost anywhere.

The region in which I have been working is about forty miles wide and sixty miles long, extending from the Sierra Madre Mountains on the north to the ocean on the south. This region is varied and a most favorable one, containing, as it does, mountains, canyons, hills, valleys, swamps, and ranging in altitude from sea level to 10,000 feet. I, therefore, had a wide range of conditions from which to study the Collembola and as is to be expected, found many differences (figures 1 and 2).

Folsom (1901) has written an article on the distribution of Holarctic Collembola, the only contribution on this subject. In it he states that no less than one hundred and fifty-two species of Collembola are known to occur in North America, of which thirty at least are shared with Europe. Since then this number has been increased. Of those seven that Folsom lists as occurring abundantly throughout Europe and the United States, I

found *Isotoma viridis, Isotoma palustris, Aphorura inermis,* and *Entomobrya multifasciata.* Another species that I found here that is widely distributed is *Isotoma besselsii,* having been reported from Polaris Bay, Spitzbergen, Massachusetts


Figure 2. Position of the Claremont-Laguna region in California.

Bay, and Cold Spring Harbor. *Neanura gigantea,* which has not been found except in Siberia, Alaska, and Yenisei River, were found here in considerable numbers. I am pleased to be able to report *Pseudosira domestica* from this region, as it has only been recorded from England and as very rare. *Sinella curviseta* has not been found in any other place in the United

States and we share it with England. I also found two new species of *Tullbergia* here and two of *Drepanura,* and it is the first time these genera have been recorded from the United States.

In regard to local distribution, the forms found most widely were *Isotoma viridis, Entomobrya multifasciata, Neanura gigantea, Entomobrya binoculata* and a new species of *Isotoma.* These all were very abundant and found in nearly all the localities from which Dr. Hilton or I have collected.

There was not a marked difference between the Collembola found in the different canyons. San Dimas and Palmer's canyons had the greatest number of different forms, due no doubt to the great abundance of vegetation in those canyons. The *Drepanura* were confined entirely to the high altitudes, being found only on the slopes of Mt. San Antonio at 6000 and 7000 feet. Three species of *Aphorura, Isotoma palustris, Tomocerus vulgaris* and *Entomobrya* were also found only in the mountains.

The two species of *Tullbergia* were the only forms found exclusively in the hills. The forms found entirely in the valley were *Cyphodeirus albinus, Sinella curviseta, Entomobrya clitellaria, Isotoma minima,* and a member of the genus *Achorutes.*

The forms that were peculiar to Laguna Beach were *Isotoma besselsii, Isotoma bidenticula,* and *Entomobrya laguna.* These were found as far out in the ocean as one was able to turn over the rocks at low tide. This is the first time that the genus Entomobrya has been reported from under rocks in salt water.

With the exception of Schött, who has described some thirty species, mostly from the northern part of the state, no work has been done in California. This region around Claremont has not been touched at all and as is to be expected several species were found that had never been described before. Many interesting points were also gained on the subject of distribution. As yet I have by no means exhausted the field and I hope some time to be able to continue the study of this region.

## KEY TO THE FAMILIES, GENERA AND SPECIES OF *COLLEMBOLA*

### Key to the Order COLLEMBOLA

A. Furcula present.
  B. Furcula attached on the penultimate segment.
    C. Abdomen globular, little longer than broad; segments fused together; scales never present; claws two; antennæ four-jointed; no post-antennal organ. Family SMYNTHURIDÆ
    CC. Abdomen sub-cylindrical, longer than broad, segments free; scales present or absent; claws two. Family ENTOMOBRYIDÆ
  BB. Furcula attached to antepenultimate abdominal segment. Body sub-cylindrical, segments free; antennæ four-jointed; claws two or one. Family PODURIDÆ

AA. Furcula wanting. Family APHORURIDÆ

### Family SMYNTHURIDÆ

There is little danger of confusing the members of this family with those of any of the other families for the globular abdomen and its fused condition easily distinguishes it. The head is carried in a vertical position, the ventral tube is long and well developed, ocelli sixteen. The majority of this group are beautifully marked.

I found fewer specimens of this family than of any of the others and in fact I hunted for a year and a half before I found any at all and then only a few specimens which have not yet been determined.

### Key to the Family SMYNTRURIDÆ

A. Antenna IV shorter than antenna III. The distal part of antenna III ringed. Genus *Papirius*
  B. Antenna IV longer than antenna III. Antenna III not ringed. Genus *Smynthurus*

Genus *Papirius* Lubb.

I found one member of the genus near Escondido in leaves under a sumach bush.

Genus *Smynthurus* Lat.

I collected several specimens of this genus on pools of water after a hard rain, associated with a new species of *Isotoma;* one specimen from a tree in Cow Canyon and another specimen from Sycamore Hill, Laguna Beach, none of which I have yet been able to identify.

## Family ENTOMOBRYIDÆ

This family is a large one, containing many genera as well as species and was the one found most commonly in this region. The genera differ greatly from each other and consequently by the later authorities have been divided into several sub-families.

### Key to the Family ENTOMOBRYIDÆ

A. Body naked or covered with hairs.
  B. Two ocelli on either side of the head. Genus *Sinella*
  BB. Usually eight ocelli on either side of the head.
    C. Abdomen III and IV about equal in length. Genus *Isotoma*
    CC. Abdomen IV at least four times as long as III. Sub-Family Entomobryinæ
      E. Distal end of furcula curved, without anteapical tooth. Genus *Drepanura*
      EE. Mucro with two hooks. Genus *Entomobrya*

AA. Body covered with scales.
  B. Eyes twelve or none; antennæ ringed on III and IV. Sub-Family Tomocerinæ
    C. Eyes twelve. Genus *Tomocerus*
  BB. No antennal segments ringed.
    C. Ocelli wanting. Genus *Cyphodeirus*
    CC. Ocelli present.


Figure 1. Map of the Claremont-Laguna region.


Figure 1. Map of the Claremont-Laguna region.

D. Pronotum simple, metathorax simple; saltatorial organ smooth; abdomen IV almost three times as long as III.

Genus *Pseudosira*

Genus *Sinella* Brook.

There is but one species of this genus known here so far and it is the same as that upon which the genus was founded, *curviseta*.

*Sinella curviseta* Brook.

(Plate I, Figs. 1-3)

*Sinella curviseta* Brook, on a new gen. of Coll. allied to Degeeria, 1882, p. 544. Collinge and Shoebotham, Jr. econ. biol. v, p. 114, 1910.

*Description:* Color—Opaque white. Antennæ long and slender; I short, II longer than III, IV equals II. Ocelli—Four, two on each side of the head, one behind the other, some distance apart. Claws—Two; superior long, curving slightly, armed with three teeth, the proximal large and opposite each other, the distal smaller; inferior short, stout, one-half length of superior; no tenent hairs. Furcula—Dentes and mucrones longer than manubrium, dentes serrated; mucrones small, long, teeth two and a long basal spine reaching nearly to the distal tooth. Segment of body greatly fused.

*Variation:* Those described by Collinge are yellow in color with mottlings of reddish pigment. There was no color on my specimens.

*Habitat:* Claremont, under flower pots in garden in September; Cucamonga Canyon; San Antonio Canyon, altitude 5000 feet, in black loam in grass roots.

Collinge found his in flower pots in a greenhouse in Berkhamsted.

Genus *Isotoma* Bourlet

So far this genus is represented in our fauna by eight species.

The body is sub-cylindrical with the abdominal segments subequal, in which respect it is different from *Entomobrya*. The antennæ are four-jointed, short, not much longer than the

head. In most species there are sixteen ocelli present. The postantennal organ is usually present and is of importance in species determination. The claws are two and often bear teeth on inner and outer margins. The furcula may be poorly developed or well developed and the mucrones are more highly developed in this genus than in any of the others.

### Key to the Genus *Isotoma*

A. Furcula short, not reaching ventral tube.
  B. Mucrones bidenticulate.
    C. Claws unarmed; manubrium longer than dentes; antennæ little longer than the head; gray-blue or brown. *bidenticula*
    CC. Superior claw armed; dentes twice the length of the manubrium; antennæ same length as head; light green in color. *aquæ* n. sp.
  BB. Mucrones tridenticulate.
    C. Mucrones with second and third teeth opposite.
      D. Claws unarmed. *besselsii*
      DD. Claws armed; superior, two teeth on inner margin, two on outer; inferior, one tooth on inner margin. *aspera* n. sp.
    CC. Mucrones with second and third tooth not opposite, third tooth smaller; claws unarmed. *minima*

AA. Furcula reaching nearly or quite to the ventral tube.
  B. Mucrones, tridenticulate; no regular markings; inner margin of superior claw bidentate; postantennal organ ovate to oval. *viridis*
  BB. Mucrones quadridenticulate.
    C. Long pre-apical tooth, minute apical tooth; claws armed; length 3 mm. *catena*
    CC. Apical tooth of mucrones projecting as far as pre-apical. Dorsal median dark stripe. *palustris*

*Isotoma bidenticula* Guthrie

(Plate I, Figs. 4-5)

*Isotoma bidenticula* Guthrie, Coll. of Minn. geol. nat. hist. surv. of Minn., zool. series 4, pp. 1-110. Bacon, P. C. jr. ent. and zool., vol. IV, pp. 841-845.

*Description:* Length—1 mm. Color—Dark, dull brown, mottled; ventral side dark, light at the junction of the body segments, furcula and legs light. Antennæ—Short, little longer than head; I shortest, II longer than III, and IV longest. Ocelli—Sixteen. In each eye spot there are two which are smaller than the other six. Postantennal organ is present and elliptical. Claws—Unarmed. Furcula—Short, not reaching ventral tube; not slender and tapering; manubrium slightly longer than dentes and mucrones together. Mucrones—Bidenticulate; first tooth horizontal, long, slender, curving but slightly; second tooth vertical and curves slightly cephalad.

*Variation:* My specimens differ from those described by Guthrie in regard to the antennæ and ocelli. He describes antenna III as being longer than II and the ocelli in each eye spot all the same size.

*Habitat:* These were found in great numbers at Laguna Beach under the largest rocks below the mean tide mark at low tide.

*Isotoma aquæ* n. sp.

(Plate I, Figs. 6-9)

*Description:* Length—1.55 mm. Color—To the eye the specimens look light green but under the microscope they are a mottled blue and yellow. Antennæ—Short, same length as head; I, very short; IV, II and III all subequal. Postantennal organ—Present, large, an oval rim constricted in three places. Claws—Two; superior has a minute tooth about midway, in some specimens this only occurs on the last pair of legs and in others there is a small lateral tooth also; inferior unarmed, about one-half the length of the superior and dilated somewhat at the base; tenent hair present on tibia. Ocelli—Sixteen. Furcula—Short, not reaching the ventral tube; dentes and

mucrones over twice the length of the manubrium; dentes serrated on both edges; mucro bidenticulate, distal tooth is slightly curved and about the same length as the proximal one which is curved slightly cephalad, the axes of the two teeth almost parallel. Integument—Sparsely covered with short hairs.

*Variation:* The markings in this species are not at all regular and the color varies considerably with the yellow and brown predominating in some and the blue in others. There was a variation in the superior claw as mentioned above; however, there was no variation among the specimens in each locality.

*Habitat:* They were found in great abundance on pools of water in a newly plowed field after a hard rain; they were associated with a new species of Xenylla. Also I found them in San Antonio Canyon at Camp Baldy under rocks, and in the Ganesha Hills under the same condition, but they were not very abundant in either of these localities. Also they were found in San Dimas and Lytle Creek canyons.

### *Isotoma besselsii* Packard

(Plate I, Fig. 10)

*Isotoma besselsii* Packard, 1877. Explorations of the Polaris Expedition to North Pole. Amer. nat. XI, 51-53. Packard, 1877, Amer. nat., p. 51-52 (footnote). MacGillivray, Can. ent. XXIII, p. 273. Davenport, 1903, Coll. of Cold Spring Beach, Cold Spring Harbor, mon. II. 1905 (Axelson) Linnanienii zur Kennt. der Aptery., vol. 7, vär. Bacon, P. C. jr. ent. and zool., vol. IV, pp. 843-845.

*Description:* In general appearance they look almost exactly like the *I. bidenticula,* although slightly smaller. Length—.75-1. mm. Color—Brown, yellow at junction of segments; furcula and legs light; ventral side dark. Antennæ—About as long as head; I shortest, IV longest, II and III subequal. Ocelli—Sixteen. Claws—Slightly curved; superior wide at the base but narrow at the apex; inferior with inner margin dilated at the base. Furcula—Short, stout, not reaching ventral tubes; manubrium slightly longer than dentes; mucro tridenticulate; distal tooth

long and but little curved, second and third teeth of about the same length, vertical, on opposite sides of the mucrones and nearly opposite each other.

*Variation:* MacGillivray described the antennæ, "First and second segments dilated, as broad as long and twice as broad as the third and fourth." In my specimens I is as broad as long, but this is not true of II. Also I and II are not as broad as III and IV.

*Habitat:* A very few of these specimens were found under the rocks during low tide at Laguna Beach.

C. B. Davenport has collected specimens from the sand at Cold Spring Beach, Massachusetts, and they have been taken from Spitzbergen, Polaris Bay, and Massachusetts Bay.

*Isotoma aspera* n. sp.

(Plate II, Figs. 1-4)

*Description:* Length—1.5 mm. Color—Great variation, dirty white with no markings to mottled gray. Antennæ—Longer than head, IV longest and thickest, II and III subequal, I little shorter than II and III. Ocelli—Widely separated, sixteen. Postantennal organ—Elliptical with a rim. Claws—Two; superior armed with two teeth on the inner margin, and two teeth on the outer margin; inferior, wide and stout, curved on the inner margin. Furcula—Does not reach ventral tube; dentes nearly three times manubrium; mucrones short and curving, tridenticulate, second and third teeth opposite. Integument—Very hairy.

*Variation:* The color varies a great deal.

*Habitat:* Camp Baldy, altitude 4700 feet, March. Lytle Creek, April; San Dimas, left fork.

*Isotoma minima* Guthrie

(Plate II, Fig. 5)

*Isotoma minima* Guthrie, 1903. The Collembola of Minnesota, Geol. and nat. hist. surv. of Minn. zool., series 4, pp. 1-110.

*Description:* Length—.75 mm. Color—Grayish blue. Antennæ—Short, little longer than head; IV longest and swollen;

II and III subequal; I one-half length of II. Ocelli—Sixteen. Postantennal organ—Long, elliptical, emarginate. Claws—Two, unarmed; superior curving slightly; inferior somewhat dilated at base; tenent hair present, long and simple. Furcula—Short, does not reach ventral tube; manubrium, stout and thick; dentes serrated and with mucrones about as long as manubrium. Mucrones—Tridenticulate, long and narrow; distal tooth almost straight, the antedistal and proximal parallel and at right angles to the distal tooth, proximal tooth smaller. Integument—Sparsely haired.

*Habitat:* A large number of specimens were found in a rotten log at the Chino swamps. Several specimens were also obtained from San Dimas Canyon. Guthrie found his in the greenhouse of the University of Minnesota under moist boxes, and outdoors under stones and damp boards.

*Isotoma viridis* Bour.

*Podura viridis* Bourlet, Mémoire Podurelles, p. 24, 1843.

*Isotoma viridis*, Bourlet, Mémoire Sco. Sc. Agri. arto. Lille. Pt. 1, p. 401, 1839. Gervais, in Walckenaer, Hist. nat. ins. Apt., III, p. 433, 1844. Lubbock, Mon. Coll. and Thys., p. 169, 1873. Parona, Laggio Catalogo Pod. Ital., p. 42, 1878; Ann. Mus. civ. st. nat. Genova, XVIII, p. 463, 1883. Reuter, Ofv. finsk, vet. soc. förk., XXXIII, p. 229, 1891. Schött, K. sven. vet. Akad. hand., XXV, no. 11, pp. 59-61, 1894. Dalla Torre, Die Hattungen und Arten der Apterygogeneam, p. 10, 1895. Reuter, Acta. Soc. Fauna Flora fenn., XI, pp. 25-26, 1895. MacGillivray, Can. ent., XXVIII, p. 58, 1896. Schäffer, Mitt. Naturk. Mus. Hamburg, XIII, pp. 184-186. Lie Pettersen, Bergens Mus. Aarb., No. 8, p. 17, 1897; ibid., no. 6, p. 12, 1898. Meinert, Videnak. Med. Naturk. Foren. Kjobenhaon, p. 169, 1897. Scherbakof, zool. Anz., XXI, p. 88, 1898. Carpenter and Evans, Proc. r. phys. soc. Edinburgh, XIV, p. 246, 1899. Wahlgren, Ofv. k. vet. Akad. Förk., LVI, p. 338, 1899. Kieffer, Berl. ent. Zeits., XLV, hft. 1-2, p. 113, 1900. Schäffer fauna, Artica. 1, lief. 2, p. 245, 1900. Guthrie, 1903.

*Isotoma cærulea* Bourlet, Mem. soc. sc. agri. Arts Lilla, p. 401,

1839. Gervais in Walckenaer, Hist. nat. ins. Apt., III, p. 433, 1844.

*Isotoma arborea* Bourlet, Mem. soc. sc. Agric. Arts Lille; Parona Laggio Catalogo Pod. Ital., 1878; Ann. mus. cic. st. nat. Genova, 1883.

*Desoria virescens* Nicolet, Recherches Podurelles, p. 59, 1841. Gervais, in Walckenaer, Hist. nat. ins. Apts., p. 248, 1844.

*Desoria cylindrica* Nicolet. Recherches Podurelles, p. 60, 1841. Gervais, 1844.

*Desoria viatica* Nicolet, 1841. Gervais, 1844.

*Desoria pallida* Nicolet, 1841. Gervais, 1844.

*Desoria ebriosa* Nicolet, 1841. Gervais, 1844.

*Desoria annulata* Nicolet, 1841. Gervais, 1844.

*Desoria fusca* Nicolet, 1841. Gervais, 1844.

*Podura annulata* Bourlet, Memoire Podurelles, p. 24, 1843.

*Podura arborea* Bourlet, ibid.

*Isotoma desmarestii* Gervais, in Walckenaer, Hist. nat. ins. Apt., III, p. 436, 1844.

*Heterotoma chlorata*, Gervais, ibid., p. 421, 1844.

*Isotoma virescens* Nicolet, Ann. soc. ent., 1847.

*Isotoma pallida* Nicolet, ibid.

*Isotoma annulata* Nicolet, ibid. Lubbock, mon. coll. and thys., pp. 175, 1873. Parona, Ann. Mus. civt. st. nat. Genova, XVIII, p. 463, 1883.

*Isotoma fusca* Nicolet, Ann. soc. ent. France, V. 1847. Lubbock, mon. coll. and thys., p. 175, 1873. Tömösvary, Math. term. kislem. Magyar Ak., XVIII, p. 124, 1882. Parona, Ann. mus. civ. st. nat. Genova, XVIII, p. 463, 1883; ibid., 2nd ser. VI, p. 143, 1888.

*Isotoma anglicana* Lubbock, Trans. linn. soc. London, XXVII, p. 506, 1862; mon. coll. and thys, p. 171, 1873.

*Isotoma lineata* Lubbock, Trans. linn. soc. London, XXIII, p. 597. 1862.

*Isotoma palustris* var. *unicolor* Tullberg, Ofv. k, vet. Akad. förk., XXVIII, p. 151, 1871.

*Isotoma palustris* var. *annulata* Tullberg, ibid.

*Isotoma palustris* var. *viridis* Tullberg, 1. sven. vet. Akad.

hand. X, p. 46. Uzel. Litzber, k. böh. Gesell, wiss. II, p. 63, 1891.

*Isotoma palustris* var. *fusca* Tullberg, k. sven. vet. Akad. hand., X, no. 10, p. 46, 1872. Uzel. Litzber, k. böh. Gesell, wiss., II, p. 63, 1891.

*Isotoma belfragei* Packard, Fifth Rep. Trust Peab. acad., pp. 33-34, 1873. MacGillivray, Can. ent., XXIII, p. 273, 1891.

*Isotoma tricolor* (in part) Packard, Fifth Rep. Trust Peab. acad., p. 34, 1873. MacGillivray, Can. ent. XXIII, p. 273, 1891.

*Isotoma purpurescens* Packard, Fifth Rep. Trust Peab. acad., pp. 34-35, 1873. MacGillivray, Can. ent., XXIII, p. 274, 1891.

*Isotoma plumbea* Packard, Fifth Rep. Trust Peab. acad., p. 35, 1873. MacGillivray, Can. ent., XXIII, p. 274, 1891.

*Isotoma palustris* Tullberg, Ofv. k. vet. Akad., förk., XXXIII, pp. 34-35, 1876.

*Description:* Length—5-6 mm. Color—Either yellow marked with purple or dark brown. Antennæ—Half as long again as the body; IV longest, II and III equal, I shortest. Ocelli—Sixteen. Postantennal organ—Ovate to oval. Claws—Superior, long, slender, tapering, armed with two teeth on the inner margin and one on the outer; inferior less than half as long, acute, apically curving, armed on inner margin; tenent hair unknobed. Furcula—Half as long as body; dentes nearly three times manubrium in length; mucrones tridentate with the teeth subequal, large, blunt; apical tooth falcate, second and third subfalcate and opposite each other. Integument—Dense, short curving setæ, with long barbellate hairs on the posterior part of the abdomen.

*Variation:* There is great variation in this species and I expect to consider this at another time.

*Habitat:* Found in great abundance in the entire region from the mountains to the sea.

### *Isotoma catena* Guthrie
(Plate II, Figs. 6-7)

*Isotoma catena* Guthrie 1903. The Collembola of Minnesota. geol. and nat. hist. surv. of Minn. zool. series 4, p. 69.

*Description:* Length—3.8-5 mm. Color—"Dirty," obscure purple above, shading down laterally to a lighter tint, and showing brownish purple beneath. The antennæ are dark purple throughout; the legs rather a weak purple. The dentes and sometimes the legs as well, show a tendency to a yellow green tint. The head is dark throughout. Antennæ—Longer than the head; IV much more slender than III, I short and stout; II, III and IV subequal. Ocelli—Sixteen. Claws—Superior, long, curving but slightly, armed. One outer and two inner teeth; inferior, short, armed with one inner tooth; no tenent hairs. Furcula—Dentes more than twice the length of the manubrium; mucrones provided with four teeth, apical one is very small and at the base of the second, the other three are large, blunt; second tooth falcate, third and fourth subfalcate and nearly opposite each other. Clothing of dense short hairs with longer ones on the posterior end of the abdomen.

*Habitat:* Found with *Isotoma viridis* at Camp Baldy among leaves near the stream, and also in Palmer's and Bear canyons and at Laguna Beach, although not abundantly. Guthrie states that he did not find the species very abundant in Minnesota and took them from under the loose bark of a log on the bank of the Minnesota River and also at Lake Vermillion.

*Isotoma palustris* Müller

(Plate II, Figs. 8-10)

*Podura aquatica cinerea* De Geer, Act. soc. roy. Ups., 1740.

*Podura palustris* Müller, Zool. Dan. Prodr., p. 184, 1776. Gmelin, Linnæus, Sept. nat. ed. XIII, p. 2911, 1788. Bourlet, Mem. soc. roy. Douai, 1842. Bourlet Mem. sur les Podurelles, p. 29, 1843.

*Aethescerus aquaticus* Bourlet, Mem. soc. roy. Douai, 1842.

*Podura psi.* Herklots, Notices Entomologigues, 1837.

*Isotoma palustris* Tullberg, Lver. Podur., p. 45, 1872. Lubbock, Monogr. coll. and thys., p. 169, 1873. Uzel, Thys. Bohemiæ, p. 62, 1890. Schött, palaearct., coll., p. 63, 1893. Reuter, Finl. Coll., p. 26, 1895. Lie Pettersen, Norges Coll., p. 16, 1896.

Schäffer, Coll. der. Umgebung von Hamburg, p. 186, 1896. Folsom, Can. ent., XXVIII, p. 48, 1896. Guthrie, Coll. of Minn., p. 71, 1903.

*Description:* Length—2.5 mm. Color—Brownish yellow with median and transverse dark bands, dark spot on head and thorax II, and distal end of each segment of the antennæ purplish. Antennæ—Little longer than the head; I shortest, III longer than II, and IV longer than III and twice as long as II. Ocelli—Sixteen. Postantennal organ—Oval. Claws—Two; superior, stout, tapering but slightly; no teeth on inner margin but on second and third pair of legs there is a minute tooth; inferior, short, about one-half length of superior, dilated at base, armed with a minute tooth on inner edge; no tenent hairs present. Furcula—Does not quite reach ventral tube; dentes nearly three times as long as manubrium; mucrones four-toothed, first is minute and at the base of the second, second and third subequal, fourth arising from the side and extending caudalward, reaching beyond the base of the third tooth. Integument—Body set thickly with short, stout brown hairs of about an uniform length.

*Variation:* Mine differ from Guthrie's in that there is no green on the legs, ventral tube or furcula. In Guthrie's specimens antenna IV is more slender than III and seldom quite as long, in mine it is longer.

*Habitat:* Camp Baldy, altitude 4700 feet, January. Slippery Elm Ridge on slopes of Mt. San Antonio, altitude 7000 feet, December. This species has been reported from Europe, Asia, Africa and North America. Guthrie found them "on the surface of stagnant water, and on leaves and rubbish along the edge of lakes and streams during the whole summer; and in winter as well, when one can find a place where the snow is sufficiently melted to allow access to their haunts."

### Genus *Drepanura*, Schött

I have found but one species of this genus.

This is essentially an Entomobryan with but one hook on the mucrones. The fourth segment of the abdomen is from

three to four times the length of the third. The ocelli are sixteen.

*Drepanura californica* Schött

(Plate II, Figs. 11-13)

*Drepanura californica* Schött, Kenntniss Kalifornischer Collembola, Bihang Till K. Svenska Vet., Akad. Handlinger, Band 17, Afd. IV, no. 8.

*Description:* Length—. Color—Yellow background with dark mottlings of blue, the proximal edge of thorax I, distal margin of thorax II, thorax III, abdomen I, and distal ends of antennæ IV, III and II, are dark; legs and furcula yellow. Antennæ—Longer than the head; I shortest, II and III subequal, IV longer than III. Ocelli—Sixteen. Claws—Two, both slender; superior armed with two teeth on the inner margin, straight, tapering gradually; inferior one-half length of superior, unarmed; tenent hair present. Furcula—Dentes plus mucrone equals manubrium, dentes serrated and covered with many plumed hairs; mucrones with one short falcate tooth, no anteapical teeth, short basal spine.

*Variation:* In the species described by Schött the mucrone is longer and more slender than mine and it doesn't have a basal spine.

*Habitat:* Bear Flats, altitude 6000 feet, November.

Genus *Entomobrya* Rondani

This genus is represented by five species in our fauna.

The Entomobrya have no scales and the segments of the abdomen are unequal, the fourth segment being from three to four times longer than the third. The ocelli are sixteen and there are no postantennal organs. The mucrones are small and always bear two teeth and sometimes a basal spine. The ventral tube is well developed. The claws are two and always armed. This genus is very common here.

Key to the Genus *Entomobrya*

A. Ocelli less than sixteen.

B. Ocelli six; greenish gray; superior claw armed with three teeth on the inner margin. *sexoculata*

B. Ocelli two; white; superior claw armed with two teeth on the inner margin. *binoculata*

AA. Ocelli sixteen,

B. Color yellow.

C. With distinct saddle-like dark markings covering thorax III and abdomen I, II, III. Superior claw armed with two teeth on the inner margin and one on the outer. *clitellaria*

CC. With well-defined dark crossbands around margin of thorax II, distal margin of thorax III, abdomen I, II, proximal margins abdomen IV, V, and VI; superior claw armed with one and sometimes two teeth on inner margin. *multifasciata*

C. Color other than yellow; mottled brown; superior armed with two teeth opposite each other. *laguna*

*Entomobrya sexoculata* Schött

(Plate III, Figs. 1-2)

*Entomobrya sexoculata* Schött, Proc. Calif. acad. sci. VI, p. 180, 1896.

*Description:* Length—1.5 mm. Color—Greenish gray in some and violet in others. Antennæ—Segments II, III and IV subequal. Ocelli—Six, three on each side of the head, two in the anterior group and one in the posterior. Claws—Superior armed with three teeth on the inner margin, the two basal ones being close together; the superior claws on the last pair of legs are armed with four teeth on the inner margin; inferior lanceolate and unarmed; one tenent hair dilated at the tip. Furcula—Long, dentes plus mucrones one and one-third longer than manubrium; mucrones with two teeth and a short basal spine. Integument—Body very hairy, many clubbed and geniculate hairs on head and thorax I and II.

*Variation:* Schött does not speak of any of his specimens having four teeth on the inner margin of the superior claw.

*Habitat:* Lytle Creek Canyon, March, San Dimas Canyon, November. Those described by Schött came from Berkeley and Alameda, California; Sonora, Mexico. So far it has never been reported outside of California and Mexico.

*Entomobrya sexoculata* Schött var ?

*Description:* This variety differs from *Entomobrya sexoculata* described by Schött in color, size and in the arming of the claws. Length—2 mm. Color—Mottled blue in some and brownish in others. Ocelli—Six, three on each side of the head. Claws—Superior armed with three teeth on the inner margin, the first and second being opposite each other, also small tooth on the outer margin. Mucrones—Two teeth with a short basal spine.

*Habitat:* Evy's Canyon, October; few.

*Entomobrya binoculata* Schött

(Plate III, Fig. 3)

*Entomobrya binoculata* Schött, 1896. N. Am. Apt., VI, p. 169. Bacon, 1913; A. Sp. of Coll. found with Termites, V.

*Description:* Length—1.5 mm. Color—Opaque white. Antennæ—Not as long as the body but longer than the head; antenna IV nearly twice the length of III, II and III about the same length, I shortest. Ocelli—Two, one on each side of the head; in some specimens there seems to be some indication of a bilobed condition of the eye spots. Claws—Two; superior is provided with three teeth, on the inner margin of which the two interior are very strong, and are placed beside each other; inferior is lanceolate and unarmed. Furcula—This does not quite reach the ventral tube, dentes slightly longer than manubrium; mucrones with two strong teeth and a slender basal one which points distally and almost reaches the middle tooth.

*Habitat:* Claremont, in twigs of live oak trees which were inhabited by termites; Cow Canyon, ant's nest; Sycamore Hill, Laguna Beach, under stones; Camp Baldy; Chino swamps. The species Schött described were found at Berkeley, California.

*Entomobrya clitellaria* Guthrie

(Plate III, Fig. 4)

*Entomobrya clitellaria* Guthrie, 1903. Coll. of Minn. geol. and nat. hist. surv. of Minn. zool. ser. 4, p. 75.

*Description:* Length—1.4 mm. Color—Orange yellow with the exception that there are dark markings on proximal edge of thorax I, distal margin of thorax II, thorax III, abdomen I, and proximal ends of antennæ IV, III and II, also dark markings between the eyes. Antennæ—Segments II, III and IV subequal, I much shorter and stouter. Ocelli—Sixteen. Claws—Two; superior armed with two well defined teeth on its inner edge; and one small one on outer which does not show on all specimens; inferior unarmed, slender, attaining to greatest width near its distal end, one tenent hair on tibia. Furcula reaches to ventral tube; dentes serrated with long hairs on its distal end; mucrones, small, two teeth with a basal spine. Abdomen IV five times as long at III.

*Variation:* Those described by Guthrie had saddle-like markings on abdomen II and the dorsal part of III. These were entirely lacking in mine. He believes this is a species varying but little in coloration, but there are considerable variations in my specimens, some of them having no markings except on the antennæ and head.

*Habitat:* Claremont, under leaves; Chino, on a tank platform twenty feet above ground, among moist mass of leaves. Guthrie obtained his specimens under bark of pine trees in woods in the northern part of Minnesota.

*Entomobrya multifasciata* Tullberg

(Plate III, Figs. 5-6)

*Podura fasciata,* Say., Jour. acad. Phil., II, p. 12, 1821.

*Podura variegata* Guer. and Per., Gen. des ins., 1838.

*Podura simplex* Koch, Fauna Ratesbonenais, Herrick. Schäffer's III, p. 354, 1840.

*Podura striata* Koch, ibid., p. 354, 1840.

*Degeeria nivalis* Nicolet, Soc. Helv., p. 70, 1841.

*Degeeria lanuginosa* Nicolet, Soc. Helv., p. 74, 1841.

*Degeeria disjuncta* Nicolet, Soc. Helv., p. 71, 1841.
*Degeeria cortocalis* Nicolet, Soc. Helv., p. 72, 1841.
*Degeeria nivalis* Lubbock, Notes on the Thys., p. 594, 1861.
*Degeeria nicoletii* Lubbock, Linn. soc. trans., p. 229, 1867.
*Degeeria muscorum* Tullberg, Fört. Ofv. Lv. Podur., p. 148, 1871.
*Degeeria arborea* Tullberg, Fört. Ofv. Lv. Podur., p. 148, 1871.
*Degeeria marginata* Tullberg, Fört. Ofv. Lv. Podur., p. 148, 1871.
*Degeeria decemfasciata* Packard, Thys. Essex Co., Mass., p. 40, 1873.
*Degeeria pulchella* Ridley, Ent. Mo. Mag., XVII, p. 270, 1881.
*Entomobrya multifasciata* Brook, Revis Gen. Ent., 1883. Uzel. Thys. Bohemiæ, p. 57, 1890. Schött, Palaearct. Coll., p. 49, 1893. Schäffer, Coll. V. Hamburg, p. 197, 1896. Collinge and Shoebotham, jr. econ. biol., V, p. 113, 1910. Guthrie, Coll. of Minn., p. 77.

*Description: Length*—1.5 mm. Color—Yellow with well-defined dark markings around margin of thorax II, distal margin of thorax III, distal margins of abdomen I, II, proximal margin abdomen IV, V and VI; distal ends of the antennæ segments I and II are also dark; anchor shaped mark on the head pointing distally. Antennæ—About half the length of the body, segments II, III and IV subequal. Ocelli—Sixteen. Claws—Two; superior armed with one tooth about the center of the inner margin, and usually there are two teeth. Small tooth on the outer margin, those taken from Laguna and San Diego were armed with three teeth on the inner margin; inferior lanceolate and unarmed. Furcula—Not passing the ventral tube; dentes plus mucrones longer than manubrium; mucrones, two teeth.

*Variation:* This species is quite variable and several varieties have been described as different species. Brook gives the most complete description of the markings. I find great variation in mine; the anchor-shaped mark was found only on the specimens from Laguna Beach.

*Habitat:* Chino swamps, rotten log; San Diego, flower pot; San Dimas Canyon, May. Claremont, Indian Hill; Laguna Beach, Sycamore Hill, February. This is one of the most widely distributed of the Collembola and occurs abundantly throughout Europe and the United States.

*Entomobrya laguna* Bacon
(Plate III, Figs. 7-9)

*Entomobrya laguna* Bacon, 1913. A New Sp. Coll. from Laguna Beach, Jr. ent. and zool., V, p. 202.

*Description:* Length—2 mm. Color—Dark brown mottlings with yellow ground color except on ventral side of body, furcula, thorax I, and the beginning of each segment; antennæ and legs dark blue. Antennæ—Three times as long as head; four segments subequal in length, IV longest, I shortest, II and III equal. Ocelli—Sixteen, eight in each eye spot, six large and two smaller ones. Claws—Two, wide at base and then become narrow and pointed; superior armed with two teeth opposite each other and at the end of the dilated portion; inferior armed on the outer side about midway with a very minute tooth not visible on some of the claws. On the three pairs of legs the claws vary somewhat; on the first the claws are about equal in length and both about equal in length and in width at the base, the inferior slopes abruptly into a point; on second pair the superior is the longest, the base of the inferior is not rounded but changes abruptly, making an angle; on last pair the claws are farther apart, equal in length and the inferior is more curved than on any of the others. Furcula—Dentes and mucrones a little longer than manubrium; dentes serrated and densely covered with plumed hairs; mucrones, two teeth, no base spine; distal tooth falcate. Integument—Body covered with fine hairs with many large geniculate ones on the anterior part of the body and short clubbed ones on the last segment of the abdomen.

*Habitat:* Laguna Beach, on the under side of large rocks as far out in the water as it was possible to turn over the stones. They were very abundant and were collected in great numbers during July to September.

## Genus *Tomocerus* Nicolet

This genus seems so distinct from the other members of the family Entomobryidæ that some good authorities recognize a family Tomoceridæ.

The eyes are twelve, six on each side of the head. The antennæ are long but do not exceed the body in any of my species. The third and fourth segments of the antennæ are subdivided in short rings. The claws are armed and the teeth simple. The tenaculum does not vary greatly, the base bears anterior setæ which differ somewhat. Each dentes is divided by two transverse sutures into three regions and there are spines on the middle and proximal regions. These spines furnish good specific characters. The form of the mucrone is distinctive of Tomocerus. Each bears, on the closed side, two large proximal teeth, an apical tooth and a series of small intermediate teeth.

I have a large number of specimens of this genus but they vary so from those described by Folsom (1913) that I am not sure that I have more than two species. Folsom uses the dental spines as one of the principal characters for distinguishing the species. But among my specimens I am unable to find even two that have the number and arrangement of the spines the same. Therefore I cannot use them entirely in classification.

### Key to the Genus *Tomocerus*

A. Intermediate dental spines unequal, with a large spine near the middle of the series; one large distal spine.
  B. Teeth of superior claw, four to seven.
    C. Dental spines simple. *vulgaris*
  BB. Teeth of superior claw, two. *bidentatus*

### *Tomocerus vulgaris* Tullberg

(Plate IV, Fig. 1)

*Macrotoma vulgaris* Tullberg, 1871; 1872. Uzel, 1890.

*Tomocerus plumbeus* Packard, 1873.

*Tomocerus vulgaris* Tullberg, 1876. Reuter, 1891; 1895. Brook, 1883. Dalla Tovre, 1888. Schött, 1894. Schäffer, 1896, 1900a; 1900b. Poppe and Schäffer, 1897. Scherbakov, 1898.

Carpenter and Evans, 1899. Carl, 1899. Skorikow, 1900. Absalon, 1903. Börner, 1901. Krausbauer, 1901. Agren, 1903. (Axelson) Linnaniemii, 1905, 1907, 1912. Wahlgren, 1906b.

*Podura vulgaris* Vorgts, 1902.

*Tomocerus niger* Guthrie, 1903.

*Description:* Length—4 mm. Color—Blue, when denuded of scale, yellow. Antennæ—Two-thirds as long as the head and body. Ocelli—Twelve. Claws—Superior armed with four to six teeth on inner margin; inferior lanceolate and armed with a minute tooth. Dental spines seventeen to twenty-three on each side. Mucrones from five to seven intermediate teeth.

*Variation:* In speaking of the dental spines of this species, Folsom (1913) gives usually thirteen to fifteen in number, and rarely seventeen or eighteen. The majority of mine had nineteen to twenty-one.

*Habitat:* Cucamonga Canyon, Palmer's Canyon, Fern Canyon, San Antonia Canyon; altitude 7000 feet.

### *Tomocerus bidentatus* Folsom

(Plate IV, Figs. 2-3)

*Tomocerus bidentatus* Folsom, 1913. Proc. U. S. Nat. Mus., vol. 46, pp. 451-472.

*Description:* Length—2 mm. Color—Yellow, mottled with dark pigment. Antennæ—Shorter than body. Ocelli—Sixteen. Claws—Superior stout, armed with two teeth; inferior lanceolate. Dental spines sixteen. Mucrones with four to seven intermediate teeth.

*Habitat:* Palmer's Canyon.

## Genus *Cyphodeirus*

Only one species of this genus has been found here. It is really a white, eyeless Entomobrya with scales. *albinus*

### *Cyphodeirus albinus* Nicolet

(Plate IV, Figs. 4-5)

*Crystalpoduran* O. Fabricus, 1783. Danske V. denck., p. 303.

*Cyphodeirus albinus* Nicolet, 1842. Hist. des Podurelles, p. 67.

*Lepidocyrtus albinus* Gervais, 1844. Hist. nat. ins., Walckenaer, vol. III.
*Lepidocyrtus albinus* Lubbock, 1867, Notes on Thys., pt. III, p. 301.
*Cyphodeirus albinus* Tullberg, 1871, Fört. Ofv. sv. Podur., p. 103.
*Cyphodeirus albinus* Tullberg, Sver. Podur., p. 38.
*Beckia albinus* Lubbock, 1873, Monogr. Coll. and Thys., p. 49.
*Cyphodeirus albinus* Uzel, 1890, Thys. Bohem., p. 49.
*Cyphodeirus albinus* Schött, 1893, Palearctic, Coll., p. 44.
*Cyphodeirus albinus* Reuter, 1895, Finl. Coll., p. 16.
*Cyphodeirus albinus* Schäffer, 1896, Coll. V. Hamburg, p. 199.
*Tullbergia immaculata,* Lie-Pettersen, 1896, Norg. Coll., p. 16.
*Cyphodeirus albinus* Guthrie, 1903, Coll. of Minn., p. 82.
*Cyphodeirus albinus* Collinge and Shoebotham, 1910, Apterygota of Hert., p. 119.

*Description:* Length—1 mm. Color—White. Antennæ—Short, slightly longer than head; I shortest, II pear shaped and longer than III, IV as long as II and III. Ocelli—Wanting. Claws—Two; superior armed, two teeth on inner margin, the basal one being the longest; inferior runs out in two diverging points; one simple tenent hair on the tibia. Furcula—Dentes longer than manubrium and twice the length of the mucrones; mucrones with two teeth and a short basal spine.

*Variation:* Those I have found here do not vary among themselves but differ in some instances from those described by other authors. Lie-Pettersen gives the size of those he described as 1.5 mm. and those of Guthrie correspond to this. I didn't find any that were quite that large. Lie-Pettersen seems to have overlooked the smaller tooth on the superior claw and Collinge the same, for it does not appear in either of the descriptions.

*Habitat:* Claremont, under a rock. This was the only place that I found them. Nicolet says that they "inhabit worm-eaten trunks" and Collinge found his in ants' nests, while Guthrie found them very common among damp decaying leaves

in the woods of Minnesota. They have been reported from Finland, Scandinavia, Bohemia, Germany and Minnesota.

### Genus *Pseudosira* Schött, Börner

This is a scaled genus similar to Entomobrya, one species is found here, and has been described by Lubbock from England. They seem to live in much dryer places than the other Collembola.

### *Pseudosira domestica* Nicolet

*Degeeria domestica* Nicolet, Rech. p. s. á l' hist. d. Pod., 1842, p. 76.

*Seira domestica* Lubbock, Monograph, 1873, p. 144.

*Pseudosira domestica* Collinge and Shoebotham, jr. econ. biol, V, 1910, p. 115.

*Description:* Length—2.65 mm. Color—Steel blue with some brown. Antennæ—Slender, long; I shortest, II and III subequal; IV not quite twice as long as III but little over twice as long as I. Ocelli—Sixteen. Claws—Two, both slender, superior three teeth, inferior unarmed; tenent hair on tibia. Furcula—Long and slender, dentes plus mucrones longer than manubrium, dentes serrated; mucrones, one tooth with basal spine. Abdominal segments unequal; IV almost three times as long as III.

*Variation:* Those described by Collinge had no basal spine while mine have.

*Habitat:* Found under a rotten log in fairly dry sand in Cucamonga Canyon. Nicolet in describing this species, says that it is found in houses and is very rare. Collinge found it on and under flower pots in a greenhouse.

## Family PODURIDÆ

This family is a large one and is less specialized and more primitive than the Entomobrya. The antennæ are short and many of them have sense bulbs at the end. Ringed antennæ are entirely unknown. The claws show reduction. In some genera the inferior claw is little more than a bristle, while in

others it is absent entirely, still others have the claws well developed. The furcula is usually short and weak, in some species it is so short that it is hard to see that there is any. But two of the genera of this family have been found in this region.

KEY TO THE FAMILY PODURIDÆ

A. Feet two-clawed; two anal horns; postantennal organ present; ocelli, sixteen. Genus *Achorutes*

AA. Feet with a single claw; no postantennal organ present; two anal horns; ocelli, ten; furcula short but very slender. Genus *Xenylla*

Genus *Achorutes* Templeton, Schäffer

The tarsi have two claws. The ocelli are sixteen, the antennæ short and four-jointed. The post antennal organ is present, pseudocelli are absent. The body is cylindrical with the segments subequal. The furcula is stout with a heavy manubrium and a thick dentes that tapers but little. The anal horns are sometimes long and curving, while again hardly visible.

Our two species of this genus are both new.

KEY TO GENUS *Achorutes*

A. Anal horns long, two times papillæ, dentes with spikes, mucro lamellate with two teeth. *californica* n. sp.

AA. Anal horns long, four times papillæ, dentes without spikes; mucrones, lamellate, with a raised rim on distal end, no teeth. *citri* n. sp.

*Achorutes californica* n. sp.

(Plate IV, Fig. 6-11)

(Plate V, Fig. 1)

*Description:* Length—1.5 mm. Color—Yellow with brown spots, black spot in middle of the head between the eyes. Antennæ—Length of head. Ocelli—Sixteen. Postantennal organs—Composed of five tubercles on each side, the two largest are oval and have their long axis at right angles to the

antennæ, the other three tubercles are grouped behind, the center one being round and the other two oval with their long axes parallel to the axes of the antennæ, those on each side differ slightly. Claws—Two; superior very stout and slightly curving, armed with a tooth situated about midway on the inner margin; inferior about one-half length of superior, dilated at base, interrupted half way, making a sharp angle and ending in a spine; one long, simple, straight tenent hair. Furcula—Dentes is twice the length of the mucrones, bears six long hairs or spines, the shortest one being next to the mucrones and the others gradually becoming longer; mucrones have two teeth. Anal horns—Two, twice the length of the papillæ, stout and curving. Integument—One long spine to each segment, except at the posterior end of the abdomen where they are more numerous, also two or three short curved ones on each segment.

*Habitat:* West Fork of Palmer's Canyon, in the gills of mushrooms (*Marasmius*), very abundant; mouth of Ice House Canyon, altitude 5000 feet, among pine needles; Camp Baldy, altitude 4700 feet, in rotten log; Chino swamps.

*Achorutes citri* n. sp.

(Plate V, Figs. 2-5)

*Description:* Length—1.5 mm. Color—Steel blue. Antennæ—Shorter than head. Ocelli—Sixteen. Postantennal organ—Four tubercles on each side of the head, oval to elongate. Claws—Two; superior very long and curving, armed with one tooth about midway; inferior dilated at the base, forming a right angle, and extends as a long seta two-thirds the length of the superior. Furcula—Mucrones broad, lamellate, rounded at distal end with a rim. Anal horns—Extremely long, sharp, four times length of papillæ.

*Habitat:* Found in great abundance in a flume in an orange orchard near Claremont, also the rotten oranges were covered with them; January.

*Genus Xenylla* Tullberg

This genus is characterized by the absence of the inferior claws and postantennal organs; by having the ocelli reduced

to ten; the presence of anal horns, and a small, weak furcula. The genus is not a large one but three species have been found here, one of which Prof. Folsom will probably describe later.

KEY TO THE GENUS *Xenylla*

A. Mucrones lamellate, color yellow with blue semicircular spots, claws slightly curved. *collis* n. sp.

AA. Mucrones narrow, slender and tapering.

B. Mucrones straight, no hook; claws slightly curved, two tenent hairs; anal horns short, little longer than papillæ; color, steel blue. ..... n. sp.

BB. Mucrones notched, forming a hook; claws greatly curved, one tenent hair; anal horns two, short; color, yellow with dark spots. *paludis* n. sp.

*Xenylla collis* n. sp.

(Plate V, Figs. 6-8)

*Description:* Length—1.3 mm. Color—Yellow background with blue semi-circular spots on it; these are fairly far apart and not dense. Antennæ—Segments III and IV fused, I shortest; same length as head. Ocelli—Ten, five on each eye spot. Claws—One, slightly curving and fairly stout, two long tenent hairs. Furcula—Very short, only reaching about one-third distance to ventral tube; mucrones, lamellate. Anal horns—Two, short, curved, on separate papillæ close together, a trifle longer than papillæ. Integument—Finely granular, hardly any long spines except two or three at the posterior end, most of the hairs short and slightly curved.

*Habitat:* Pomona, Ganesha Park, under bark of alder tree, February.

*Xenylla* ..... n. sp,

To be described later.

*Habitat:* Claremont, on pools of water in a newly plowed field after a hard rain; February. Cucamonga Canyon, in the soil under leaves.

*Xenylla paludis* n. sp.

*Description:* Length—1.3 mm. Color—Yellow with dark spots. Antennæ—Shorter than head. Ocelli—Ten, five on each side of the head. Claws—One, unarmed, short and greatly curved; tenent hairs, one. Furcula—Short, slender and weak. Mucrones, one small hook. Anal horns—Two, short, little longer than papillæ.

*Habitat:* Chino swamp, April, in rotten log.

## Family APHORURIDÆ

These are the most primitive of the Collembola, lacking the furcula. They are slow-moving, sluggish, and are found mostly in the moist soil or rotten wood. Three genera of this family are represented here.

### Key to the Family APHORURIDÆ

A. Dorsal side of the body with large tubercles; abdomen ending in four rounded tubercles; postantennal organ present or absent. Genus *Neanura*

AA. Dorsal side of the body without large tubercles. Pseudocelli present, postantennal organ present.

B. Feet with two claws, anal horns none or two. Genus *Aphorura*

BB. Feet with one claw, anal horns two or four, postantennal organs placed in rows. Genus *Tullbergia*

### Genus *Neanura* MacGillivray

The neanuras are sluggish insects and may easily be recognized by the broad flat shape of the body and the large tubercles. They are found usually in moist rotten wood.

Only one species of this genus has been found here and it is not the one that is found almost all over the world but one that has been reported from the Arctic region.

*Neanura gigantea* Tullberg

*Anura gigantea* Tullberg, Ofv. k. vet. Akad. förk., XXXIII, no. 5, p. 41. Schött, k. sven. vet. Akad. hand., XXV, no. 11, p. 94, 1894.

*Neanura gigantea* Schäffer, Fauna Artlica, 1, laf. 2, p. 240, 1900. Folsom, papers from Harriman Alaska Expd., XXVII, p. 87, 1902. Bacon, P. C. jr. ent. and zool., vol. VI, p. 46.

*Description:* Length—3.5 mm. Width—1.5-2.5 mm. Color—Dark blue, lighter on the ventral side. Body—Broad, flat, covered with long dark tubercles, the numbers on each successive segment being: six, eight, eight, eight, eight, eight, eight, six, two. Each tubercle bears several long setæ. Head—A little longer than the first two segments together, twice as broad as long, with thirteen tubercles. The head is divided into two parts, a raised upper portion with five small tubercles and two large tubercles containing the eyes, and a lower portion with six large tubercles. Antennæ—Short, half as long as the head, conical, with segments related in length as 4:3:2:6; on the dorsal side it is hard to distinguish more than three segments, but four show plainly on the ventral side; basal segment is round, the terminal one is as long as the other three together; no sense bulbs. Ocelli—Five in each eye spot, situated on a tubercle with three large setæ. Postantennal organs—Each composed of more than 100 clavate papillæ forming a rosette. Claws—One, short, stout, curved, armed with a minute tooth about midway; minutely tuberculate. Anal horns—Wanting. Integument—Finely tuberculate and covered with large tubercles bearing stiff yellow setæ.

*Variation:* My specimens seem to be the same as those described by Dr. Folsom except that they have one more tubercle on the anterior part of the head; this is constant in all my specimens.

*Habitat:* Cucamonga Canyon, rotten piece of wood, in November; Fern Canyon, under rocks. Palmer's Canyon, under rocks. Pomona hills, December, and Chino Hills, January, under rocks. Eucalyptus Hill, Laguna Beach, under rocks, March; Live Oak Canyon, January.

Tullberg and Schött have recorded this species from several localities in Siberia, Yenisei River, and vicinity of St. Lawrence Bay. Tullberg is confident that it does not occur in Nova Zembla, Spitzbergen or Greenland.

## Genus *Aphorura* MacGillivray

These insects are small and white, without eyes, and with an inferior claw. The postantennal organs are present and also the pseudocelli. They are very abundant in soil and under stones.

### Key to the Genus *Aphorura*

A. Anal horns wanting. ..... sp. ?

AA. Anal horns two.

B. Color yellow, each postantennal organ composed of nine tubercles. *lutea*

BB. Color white. Each postantennal organ composed of eleven tubercles. *montis*

### *Aphorura* ..... sp. ?

I have been unable to identify this species.

*Description:* Color—White. Antennæ—Shorter than head; antennæ sense bulbs present, five at the distal end of the third segment, and two blunt curved hairs at the distal end of segment IV. Eyes—Wanting. Postantennal organ—Present. Pseudocelli—Present; two at the base of each antenna, two on the anterior portion of the head, four on the posterior portion, six on thorax II and III, four on abdomen I; six, abdomen II, III, IV; ten, abdomen V; two, abdomen VI. Claws—Two, unarmed; superior tapers quickly to a sharp point; inferior, dilated at base, ending in a seta reaching to end of superior claw. Anal horns—Absent. Integument—Finely granular, hairs few, short and straight.

*Habitat:* In dirt underneath fern in San Antonio Canyon above Ice House Canyon; altitude 5000 feet; few; December.

### *Aphorura lutea* Bacon

*Aphorura lutea* Bacon, 1913. P. C. jr. ent. and zool., vol. V, pp. 43-46.

*Description:* It closely resembles *Aphorura montis* in general appearance, length, size and shape of the body. It differs though in color and the postantennal organ. Color—Yellow Antennæ—Shorter than head. Two rows of antennal organs on

III and one on IV. Ocelli—Wanting. Postantennal organs—Elliptical; composed of nine tubercles, five on the antennal side and four on the other. Pseudocelli—One at the base of each antenna. Claws—Two, unarmed. Anal horns—Two, same length as papillæ upon which they are situated. Integument—Finely tuberculate, and sparsely covered with short hairs.

*Habitat:* Bear Flats, altitude 6000 feet, in rich soil at the base of a clump of bushes; very abundant.

*Aphorura montis* Bacon

*Aphorura montis* Bacon, 1913. P. C. jr. of ent. and zool., vol. V, pp. 43-46.

*Description:* Length—1.3 mm. Color—White. Antennæ—Shorter than head, blunt; I shortest, II and III subequal; IV longest; antennal organs on III and IV, those on IV are composed of seven blunt processes; those on III are wider and composed of five processes, the ones on the outside being the longest and thickest. No eyes. Postantennal organs—Elliptical, composed of eleven raised tubercles, six on the side toward the antennæ. Pseudocelli of the head—One at the base of each antennæ. Claws—Two, unarmed; superior long and broad; inferior very short and narrow. Abdomen—Segments V and VI longest, others subequal. Anal horns—Two, situated on papillæ which are separated, about same length as papillæ. Integument—Sparsely covered with sort hairs, cuticle finely tuberculate.

*Habitat:* Bear Flats on the slope of Mt. San Antonio, 6000 feet altitude, in the soil at the base of buckthorne bushes; April.

Genus *Tullbergia*

In the genus *Tullbergia* the ocelli are wanting, the postantennal organ is present composed of a great many tubercles, pseudocelli are present and the anal horns longer than the papillæ. These insects are white and are very long and slender.

Key to the Genus *Tullbergia*

A. Anal horns, two. *collis*

AA. Anal horns, four. ..... n. sp. ?

*Tullbergia collis* Bacon

*Tullbergia collis* Bacon, P. C. jr. ent. and zool., vol. VI, pp. 84-85.

*Description:* Length—1.5 mm. Width—.3 mm. Color—White. Body—Long and slender, sparsely covered with short hairs, only two or three to a segment except at the posterior end, where there are numerous long straight bristles; segments somewhat fused. Antennæ—Shorter than head, segments subequal. Eyes—Wanting. Postantennal organ—Present, consisting of a transverse groove with four rows of tubercles with more than twenty in each row; around the outside in some specimens there is a band of modified tubercles which surround the organ. Pseudocelli—Present, one at the base of each antenna, two on posterior end of head, two on each segment of the body except the last one. Claws—One, stout, slightly curved. Anal horns—Two, situated on papillæ which are separated at the base; longer than the papillæ and about the same length as the claw.

*Habitat:* This species was taken in the hills near Pomona and Laguna Beach. This is the first time this genus has been reported from the United States.

*Tullbergia* ..... n. sp. ?

So far I have been unable to determine the species of this specimen, it is probably new and may even be a new genus. This species is very long and narrow and distinguished by the four anal horns.

*Description:* Length—1-1.4 mm. Width—.16 mm. Color—White. Body—Very long and slender. Antennæ—Shorter than head, segments III and IV fused. Eyes—Wanting. Postantennal organ—Transverse to the long axes of the body, large and elliptical, elongated, composed of very many minute papillate elements. Pseudocelli—Present, one at the base of each antenna. Claws—One, unarmed. Anal horns—Four; the two anterior ones are farther apart and shorter than the two posterior ones; over twice the length of the papillæ upon which they are situated. Integument—Finely granular; body covered with short hairs, only two or three to a segment.

*Habitat:* Under a rock in the Ganesha Hills; few.

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*(Contribution from the Zoological Laboratory of Pomona College.)*

## EXPLANATION OF PLATE I.

Figure 1. Right eye patch, *Sinella curviseta* Brook.
Figure 2. Claws, *Sinella curviseta* Brook.
Figure 3. Mucro, *Sinella curviseta* Brook.
Figure 4. Claws, *Isotoma bidenticula* Guth.
Figure 5. Mucro, *Isotoma bidenticula* Guth.
Figure 6. Mucro, *Isotoma aquae* n. sp.
Figure 7. Postantennal organ, *Isotoma aquae* n. sp.
Figure 8. Ocelli, *Isotoma aquae* n. sp.
Figure 9. Claws, *Isotoma aquae* n. sp.
Figure 10. Mucro, *Isotoma besselsii.*

## EXPLANATION OF PLATE II.

Figure 1. Claws, *Isotoma aspera* n. sp.
Figure 2. Mucro, *Isotoma aspera* n. sp.
Figure 3. Left eye patch, *Isotoma aspera* n. sp.
Figure 4. Postantennal organ, *Isotoma aspera* n. sp.
Figure 5. Mucro, *Isotoma minima* Guth.
Figure 6. Mucro, *Isotoma catena* Guth.
Figure 7. Claws, *Isotoma catena* Guth.
Figure 8. Claws, *Isotoma palustris* Muller.
Figure 9. Mucro, *Isotoma palustris* Muller.
Figure 10. Antenna, *Isotoma palustris* Muller.
Figure 11. Claws, *Drepanura californica* n. sp.
Figure 12. Mucro, *Drepanura californica* n. sp.
Figure 13. Left eye patch, *Drepanura californica* n. sp.

## EXPLANATION OF PLATE III.

Figure 1. Right eye patch, *Entomobrya sexoculata* Schött.
Figure 2. Claws on last pair of legs, *Entomobrya sexoculata* Schött.
Figure 3. Claws, *Entomobrya binoculata* Schött.
Figure 4. Claws, *Entomobrya clitellaria* Guth.
Figure 5. Claws, *Entomobrya multifasciata* Tullb.
Figure 6. Left eye patch, *Entomobrya multifasciata* Tullb.
Figure 7. Claws of first pair of legs, *Entomobrya laguna* Bacon.
Figure 8. Claws of second pair of legs, *Entomobrya laguna* Bacon.
Figure 9. Claws of third pair of legs, *Entomobrya laguna* Bacon.

## EXPLANATION OF PLATE IV.

Figure 1. Claws, *Tomocerus vulgaris* Tullb.
Figure 2. Claws, *Tomocerus bidentatus* Folsom.
Figure 3. Spines of left dentes, *Tomocerus bidentatus* Folsom.
Figure 4. Claws, *Cyphoderus albinus* Nic.
Figure 5. Antenna, *Cyphoderus albinus* Nic.
Figure 6. Right eye patch, *Achorutes californica* n. sp.
Figure 7. Claws, *Achorutes californica* n. sp.
Figure 8. Setæ near median dorsal line of thorax, *Achorutes californica* n. sp
Figure 9. Left postantennal organ, *Achorutes californica* n. sp.
Figure 10. Right postantennal organ, *Achorutes californica* n. sp.
Figure 11. Anal horn, *Achorutes californica* n. sp.

## EXPLANATION OF PLATE V.

Figure 1. Mucrone, *Achorutes californica* n. sp.
Figure 2. Mucrone, *Achorutes citri* n. sp.
Figure 3. Anal horn, *Achorutes citri* n. sp.
Figure 4. Left postantennal organ, *Achorutes citri* n. sp.
Figure 5. Setæ near median dorsal line of thorax, *Achorutes citri* n. sp.
Figure 6. Claw, *Xenylla collis* n. sp.
Figure 7. Setæ near median dorsal line of thorax, *Xenylla collis* n. sp.
Figure 8. Mucrone, *Xenylla collis* n. sp.

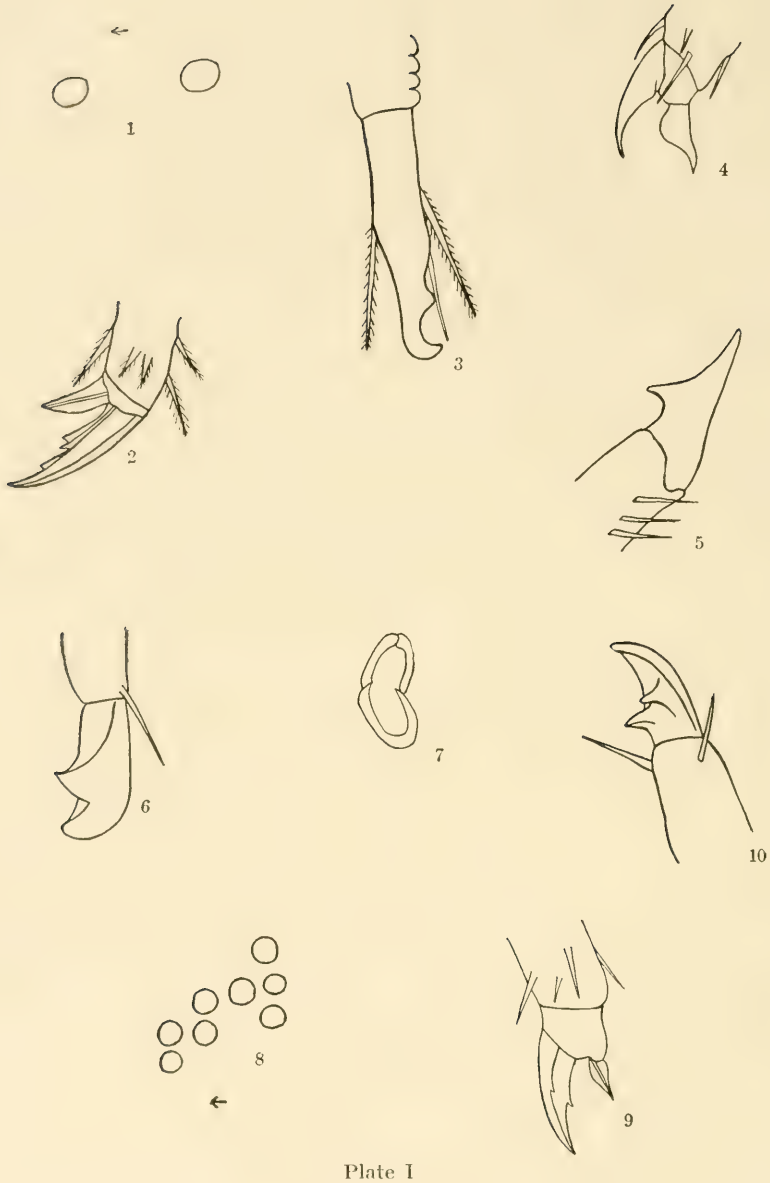


Plate I

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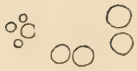

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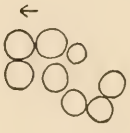

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Plate II

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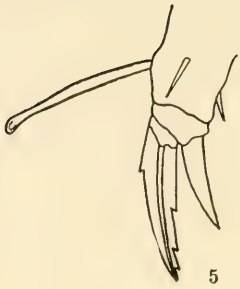

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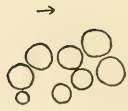

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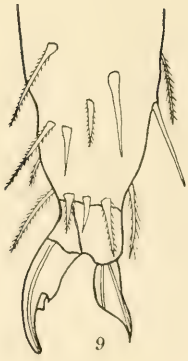

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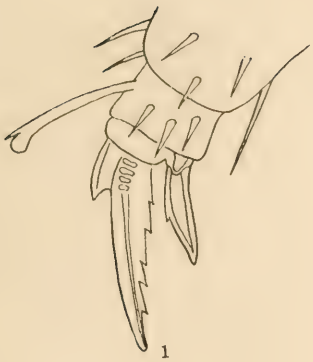
Plate III



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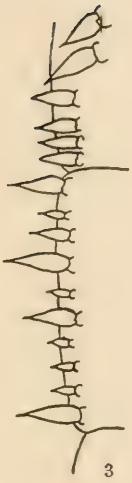

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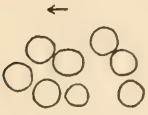

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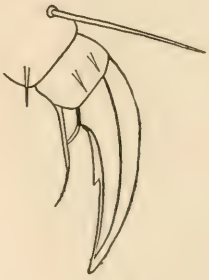

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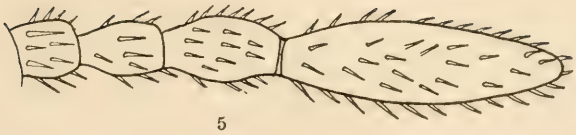

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Plate IV

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Plate V

# Hydroids of Laguna Beach

PROF. A. M. BEAN
PACIFIC UNIVERSITY, FOREST GROVE, OREGON

The identification of the hydroids included in this list was undertaken while making a general collection of the marine forms of the Laguna Beach region. The specimens were taken mostly from the miscellaneous shore collections, and there is no claim to exhaustiveness. They were, however, examined as fresh material, and nearly always with the living polyp still present. There was abundant promise of opportunity for the study of ecological and developmental problems, of which I was unable at that time to take advantage.

The region covered included a strip of shore line of about two miles in extent. Part of this is sandy beach which after a heavy tide would often be covered by the laminæ and holdfasts of *Macrocystis* and other kelps, to which hydroids were generally attached. The remainder of the shore was rocky and of a remarkably varied conformation, including tidepools, deep channels, rock tables, mussel beds, and short stretches of sand and pebbly beach. Scarcely any attempt was made at dredging, and the shore itself was by no means completely searched.

## GYMNOBLASTEA

### Family PENNARIIDÆ

*Tubularia* sp.

This single representative of the Gymnoblastea more nearly corresponds to the *T. marina* described by Torrey, '02. It is, however, much smaller, the erect branches being scarcely ever as much as 15 mm. in length, instead of 30-50 mm. The proximal tentacles are 28 and 29 in number, instead of 22-26, described for *T. marina*. There is very little appearance of annulation of the stem, and no evidence of the "stem increasing in diameter distally." The habitat is also different. *T. marina* is given as growing "between tides on the lee side of rocks exposed to the breakers of the open sea." The tubularian in question, however, was found only clustered in

among the rootlike holdfasts of the *Macrocystis* at a depth of four to six fathoms. Moreover *T. marina* is not reported as occurring farther south than Pacific Grove. There seems to be some reason for considering this a new species, but further investigation, and perhaps a study of comparative material, will be necessary to determine its systematic position.

## CALYPTOBLASTEA

### Family SERTULARIIDÆ

*Sertularella tricuspidata* (Alder)

*Sertularia furcata* (Trask)

Both of the above forms were found on the washed-up holdfasts of *Macrocystis.*

### Family PLUMULARIIDÆ

*Aglaophenia inconspicua* (Torrey '02)

Torrey's description gives "hydrocladia 3-4 mm. long." Out of a large number examined, however, I found none with hydrocladia more than 1.5 mm.

*Aglaophenia struthionides* (Murray)

Both *A. inconspicua* and *A. struthionides* were taken from the red algæ brought in by the tides.

*Plumularia setacea* (Ellis)

This form appears to have a wide variation in its bathymetric distribution. Specimens were collected from the mussels which are uncovered at mid-tide, and from the carapace of *Loxorhynchus grandis,* a deep-sea crab that is only rarely brought to shore by the highest tides.

*Plumularia lagenifera* (Allman)

Found on kelp holdfasts.

*Antenella avalonia* (Torrey)

Taken in tow-net from floating red algæ.

## Family CAMPANULARIIDÆ

Mention may be made here of one of the Campanulariidæ recently sent me by Professor Hilton of Pomona College, to whom thanks are due for many courtesies. It does not appear to be any species yet reported from this coast. Its identification, or at least an adequate description, must, however, be postponed for a future paper.

# Starfish of Laguna Beach

The following is a fairly complete list of shore forms of starfish at Laguna. All but the last one mentioned were photographed by Miss Clency at Laguna Beach.

*Linckia columbiae* Gray. Fig. 1

A large number of these were collected under stones and in tide pools near shore. A number were found with six arms, and often the arms were very irregularly developed. The power of regeneration is very marked, as may be determined from the appearance of even a small number of individuals.

*Orthasterias gonolena* Verrill. Fig. 2

This is the "soft starfish." Clark has called it *Asterias forreri.* Fisher (in first Laguna report) called it *A. sertulifera.* Verrill considers it different from either of these last two. We must thank Dr. Clark for this information, as well as for the identification of the remaining species of starfish.

This form is fairly common in the tide pools and under stones not far from shore.

*Pisaster capitatus* Stimpson. Fig. 3

This is our most beautiful species, but is not as common as the next species with which it is often found. On the points and especially among the mussel beds this species may be found. Its colors during life are beautiful with their delicate shades.

*Pisaster ochraceus* Brandt. Fig. 4

This is our most common species on the rocky points and among the barnacles and mussels, where they may be found by the dozen. The color variations are quite marked, some being a light red brown, others a darker shade. Some specimens of large size were obtained.


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*Astropecten crinaceus* Gray. Fig. 5

This beautiful starfish, with its pearl gray shades, is a deeper water form than the others. A few were found in the living condition cast up on the shore, and some were obtained from the fishermen, but they were not often found.

*Asterina miniata* Brandt. Fig. 6

These broad armed starfish were found quite often in the tide pools near shore; usually of a deep orange color, they were sometimes much lighter than this. W. A. H.

*(Contribution from the Zoological Laboratory of Pomona College)*

# Note on the Sea Urchins of Laguna Beach

Due to the kindness of Dr. H. L. Clark of Harvard, we are able now to have some clearer idea about the number of species of sea urchins found at Laguna.

*Strongylocentrotus purpuratus* Stimp

This is our most common species. It occurs by the hundreds in some of the larger tide pools, such as those near Seal Rocks. Judging from the specimens sent to Dr. Clark, the rather common greenish form, which we supposed to be distinct at first, is simply a younger form of the same species. This greenish form is more often found nearer shore under stones, where quite small individuals are abundant.

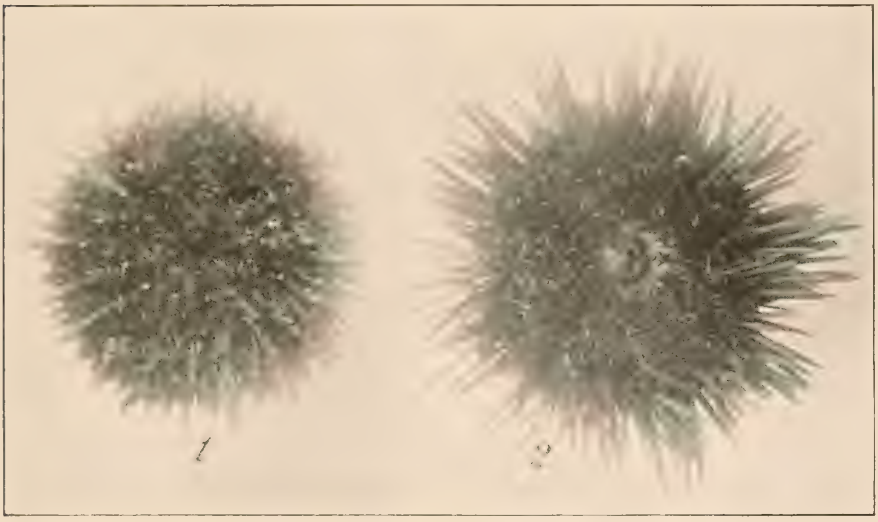


Figure 1. *Strongylocentrotus purpuratus* Stimp. Photo by Miss Clency.
Figure 2. *Strongylocentrotus franciscanus* A. Agassiz. Photo by Hamilton.

*S. franciscanus* A. Agassiz

These larger urchins are not so common as they may have been. Larger specimens may be obtained under rock ledges in deep water. Smaller forms of the same species, which seem to have long reddish spines, may be found in the tide pools, but are not common.

W. A. H.

# Notes on the Eggs of Some Laguna Beach Invertebrates

P. A. LICHTI

During the past summer a large number of species and individuals were examined for eggs. Some of these fragmentary notes may be of use to others who may carry the study further.

The serpent stars were not especially studied for the eggs, but during July several hundred were collected from various places. These were mostly of one species. About one-third of these contained well developed ova. On July 14th and 20th, six individuals of the genus *Ophiothrix* deposited eggs in the aquarium jars. During August three out of twenty specimens had ova well developed, many may have been young.

Comparatively few female sea urchins were found. Out of 50 individuals opened, 36 were males, six females, and the rest young. Miss Wang also found that the males were more numerous than the females as they were collected, four to one. Miss Wang was able to keep the sperm alive for 96 hours in the laboratory before we had running salt water.

In the common shore goose neck barnacle *Mitella,* ova and segmentation stages were found during the summer.

The common rock crab, *Pachygrapsus,* was examined many times during July and very few adult females were without eggs. During the same day mature ova and advanced embryos were found. August 10th, about half the females were without eggs. On September 4th, about two-thirds were without eggs. The early summer seems the more active spawning season.

A live female deeper sea crab, *Loporhynchus,* was caught on June 25th. The enormous mass of eggs was unsegmented and failed to segment in the laboratory, although the animal was kept alive for some time. On July 20th, another female was caught, the embryos were well advanced and it was possible to see the heart beat under the microscope. They lived only a few hours.

The sand crabs of the genus *Eremita* were found laying their eggs all summer. Some hundreds were examined, and it was found that up to September egg masses were nearly always found with the females. In the whole season, out of 236 examined, only 11 in September were without eggs. It was found that while the eggs on the swimmeretts were developing into crabs another egg mass was being formed in the ovaries, this last reached maturity about the same time that the young crabs on the swimmeretts hatch.

A species of *Cypris* was found in a pool about 1½ miles up Laguna canyon. These had many eggs on July 1; by July 17 no eggs were found.

A number of species of isopods and amphipods were found to have eggs during the summer, and during September it was very easy to obtain *Ligyda* with eggs or young, although the proportion of young stages was becoming less.

Members of the genus *Caprella* were found with eggs at different times during the summer and up into the fall.

Of the pycnogonids, the following genera were found with eggs during the summer: *Lecythorhynchus, Ammothella* of two species; *Halosoma, Pycnogonium, Palene, Tanystylum* of two species.

A number of chitons were examined, but with negative results. Probably many were young.

Some of the bivalved forms were examined, but the character of the period of reproduction is not yet determined.

The sea hare, *Aplysia,* laid its eggs in the aquarium jars during the middle and late summer.

Many of the species of nudibranchs collected during the summer were found to deposit eggs in the laboratory. One species, a light brown form, was found abundantly in kelp hold fasts. They laid coiled ribbon-like masses of eggs.

Eight different individuals of the genus *Doris* deposited eggs in the laboratory.

On July 28, two of the genus *Hermissenda* and one *Spurilla* (?) deposited eggs.

*Laila* and several unknown forms deposited eggs in the laboratory during the first part of September.

*(Contribution from the Zoological Laboratory of Pomona College)*

# A New Pseudoscorpion from California

NATHAN BANKS

Professor Hilton recently sent me a pseudoscorpion taken on the beach near water, which proves to belong to the genus *Atemnus*. Our common Florida *Atemnus* also occurs on the sea beach. The Californian species differs from the Florida form in having a larger hand and more hairy body.

*Atemnus hirsutus* n. sp.

Pale yellowish; cephalothorax a little longer than broad behind, narrowed in front, sides slightly sinuate, clothed with short, simple

bristles; mandibles not one-third the length of the cephalothorax, with a short stylet; abdomen elongate, cylindrical, the segments with apical and preapical rows of simple bristles; legs rather large, with many simple bristles, all showing trochantins. Pedipalpi large, clothed with many fine simple hairs and bristles; the trochanters bituberculate behind near tip; the femur about as long as the width of the cephalothorax, of nearly equal width throughout; the tibia about as long as femur, a little broader beyond the middle, about equally convex on each side; hand extremely broad at base, barely shorter than the tibia; fingers as long as the hand, much curved, each with some tooth-like granules and a fine toothed ridge on the apposed sides.

From Laguna Beach, California, ten feet from the ocean. (Hilton.)

# Pseudoscorpions in the Claremont-Laguna Region

MARGARET M. MOLES

Many individuals may be found in a certain vicinity. In the valleys where oak and sycamore trees grow abundantly there can be found as many as seventy-five on the lower trunk of one tree. They are all of one or two species. In all the student collections that have been carried on here in college for the last ten years there have never been more than four or five species collected. It was only through special collection that the other species were found. Very few were found under stones, where they are so often spoken of as living, and few were found among fallen leaves. Some were collected in rotten poplar and pine logs. In the marshy ground at Chino they were found under leaves and stones and were very abundant on the poplar trees.

The distribution of the pseudoscorpions extends from an altitude of 5000 down to within ten feet of the ocean.

Concerning their habits of living little can be found. Many small spiders were found in their claws, also the small mites that live underneath the bark of trees. Several experiments were tried with some that were brought into the laboratory. The results were:

1. The pseudoscorpions would not go into Eucalyptus bark.
2. They could not live in a glass dish if water was not placed in it somewhere. If water was left out, they would dry up within twenty-four hours.
3. They avoided the sunlight and would go under cover.
4. They would remain in one spot without moving for a day at a time.

### *Chelifer cancroides* Linn

*Description:* Length—including mandibles, 3 mm.; pedipalps, 4 mm.; claw, 1.5 mm. Color—Pedipalps, dark reddish brown; cephalothorax, dark reddish brown; abdomen, lighter than the palps and cephalothorax; legs, light yellow brown.

*Cephalothorax:* Evenly rounded in front; one distinct median suture, two distinct eye spots.

*Abdomen:* Twice as long as it is broad and divided into eleven distinct sutures. All of the scuta about the same size except the last one, which is a great deal shorter and broader than the rest. Each scutum is provided with two strong, spiny hairs on the outer edge.

The whole body is heavily granulated, the cephalothorax having knob-like protuberances all along the edges.

*Pedipalps:* Larger than the whole animal. Coxa, smooth; trochanter with large protuberance ending in a heavy spine on the outer edge. Femur longer than cephalothorax, pedicellate. Tibia, concave on inner edge, pedicellate, shorter than femur. Trochanter, femur and tibia strongly granulated and sparsely covered with almost clavate hairs. Claw of good size, finger a little shorter than the hand. Hand evenly convex on outer and inner edges. Finger slightly curved, smooth, with many long simple tactile hairs.

*Mandibles:* Small, fixed finger provided with many small teeth. Serrula attached throughout length of moveable finger. Spinnerets long and transparent. Mandibles are provided with five or more heavy long hairs.

*Flagellum:* Divided into four separate parts.

*Legs:* First two with trochantins, claws simple, legs covered with almost clavate hairs.

*Habitat:* Barns or buildings of this community; also found in some of the common trees, such as the oak and sycamore. This was collected in Whittier, Claremont, Lytle Creek and San Antonio canyons, and the smaller canyons near Claremont.

*Chelifer fuscipes* Banks. Figs. 1 and 2

*Description:* Length of animal, including mandibles, 4 mm.; pedipalps, 5.5 mm.; claw, 2 mm. Color—Pedipalps, reddish brown; cephalothorax, reddish brown; abdomen and legs, light brown.

*Cephalothorax:* As long as it is broad. Upper edge almost truncate, yet rounded; sides evenly convex, lower edge almost straight. Cephalothorax finely granulate and heavy, simple spine-

Figure 1. *Chelifer fuscipes* Banks. From below and above. ×25.

Figure 2. *Chelifer fuscipes,* third leg and mandible much enlarged.

like hairs placed in a definite order. One distinct median suture. Two eye spots.

*Abdomen:* Half as broad as it is long and divided into twelve scuta. The outer edges of each scutum are prolonged into curved hooked spines. The first scutum is the shortest and broadest, and has the heavier spine or hook, while the last two segments often lack the hook. The abdomen is finely granulate and at the lower edge of each scutum there are eight heavy, short, simple hairs.

*Pedipalps:* Longer than body, coxa smooth, trochanter with large protuberance ending in a strong spine on outer side; femur longer than cephalothorax, slightly concave on inner edge, convex on outer edge. Tibia pedicellate, shorter than femur. The trochanter, femur and tibia are all granulate and sparsely covered

Figure 3. Pedipalp of *Chelanops serratus* n. sp. ×50.

with short, simple hairs. Claw large, hand broad, smoothly convex on both sides; finger as long as the hand and slightly curved. It is also provided with long, tactile hairs.

*Mandibles:* Small for size of animal; fixed finger provided with small teeth. Serrula attached throughout the length of moveable finger. Flagellum divided into small parts. Spinnerets small and transparent.

*Legs:* First three legs with trochantins, claws simple, legs covered with simple hairs.

*Habitat:* Sycamore canyons, Laguna Beach, Whittier Hills, Cucamonga canyon, Arrowhead canyon, Lytle Creek canyon, Evey's

canyon, San Antonio canyon, and from oak and sycamore trees around the college campus.

*Chelifer scabrisulis* Simon

I will not describe the details of this species, because it is so much like the last described, differing from *C. fuscipes* by not having the prolonged hooks like spines, on the outer edges of each abdominal scutum. The color differs from the other two. The abdomen and legs are light brown. The cephalothorax and palps are a little darker yellowish brown.

The habitat of this species was the same as that of *C. fuscipes.* When collecting, they were generally found together.

*Chelanops oblongus* Say

*Description:* Length of body, including mandibles, 5 mm; abdomen, 4 mm.; pedipalps, 4.5 mm.; claw, 2mm. Color—Cephalothorax, light reddish brown, pedipalps darker, abdomen yellow with dark brown spots, legs pale yellow.

*Cephalothorax:* Very short for length of body. Front margin truncate, sides almost straight, lower margin slightly convex, smooth and shiny and provided with many short hairs.

*Abdomen:* Four times as long as it is wide; sub-parallel sides. Each scutum with a dark spot on each side and each dark spot surrounded by long, simple hairs arranged in a definite order.

*Pedipalps:* Nearly as long as the body, coxa smooth, trochanter stout and short; femur pedicellate, broadest part being near base, as long as the cephalothorax, inner edge slightly concave, outer edge strongly convex; tibia shorter than femur, pedicellate, strongly convex on inner edge, on outer edge slightly concave near base, but strongly convex beyond.

*Claw:* Large, finger very stout and curved, shorter than the hand. Hand very broad, very convex on outer edge, only slightly so on inner edge. The trochanter, femur and tibia are covered with stout simple hairs of varying length.

*Mandibles:* Small and short, serrula attached throughout length of finger, spinnerets small and transparent.

*Legs:* Short and stout, covered with short, stout, simple hairs.

*Habitat:* This has been reported from Palm Springs, but one specimen was found within our area at Brown's Flats, at about four thousand feet elevation, in an old pine log.

*Chelanops pallipes* Banks

Similar to *C. dorsalis,* but fingers longer than hand and very slender; tibia also slender, less convex on the inner side, hard parts with clavate hairs. Three millimeters long. (From Banks.)

*Habitat:* Los Angeles and vicinity, but has not yet been found in our immediate region.

*Chelanops acuminatus* Simon

Cephalothorax and palpi reddish brown, with short but not clavate hairs; no eye spots; pedipalps rather short, hand evenly convex on inner side at base, fingers much shorter than the hand and quite stout. 3 mm. long. (From Banks.)

*Habitat:* Claremont and Los Angeles.

*Chelanops lagunae* Moles

This species was described in the March number of this Journal, 1914.

It differs chiefly from *C. dorsalis* Banks by having two eye spots. It is a smaller species. This small species was found in Sycamore canyon, near Laguna Beach.

*Chelanops paludis* Moles

This species was described in the June, 1914, number of this Journal.

The very broad form of the abdomen is characteristic.

This was found on poplar trees and in poplar logs in the Chino swamp.

*Chelanops serratus* n. sp. Fig. 3

*Description:* Length—Pedipalps, 3 mm. Impossible to take measurements of other parts, for slide was so poorly made, but the body was small. Color—Cephalothorax and pedipalps, strong yellow brown; legs and abdomen, light yellow.

*Cephalothorax:* As long as it is broad, sides evenly convex, upper margin straight, one distinct median suture; no eye spots; surface of cephalothorax very granular.

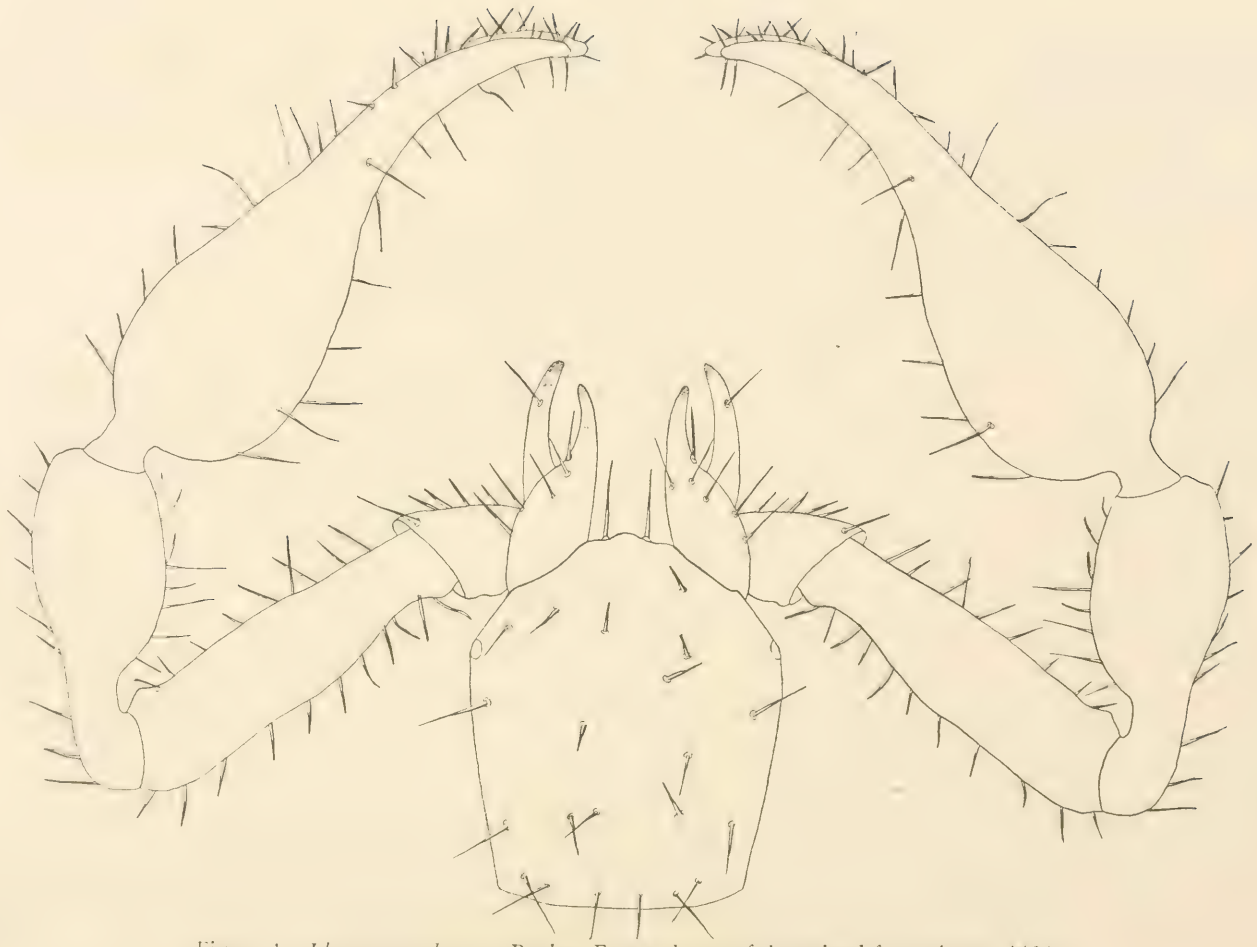


Figure 4. *Idoroncus obscurus* Banks. Forward part of the animal from above. ×25.

*Abdomen:* Badly curled up; scuta entirely covered with short almost clavate hairs.

The naming of this species is based on the short "saw-like" hairs that are all over the body. They are not globular on the end, as the clavate hairs, but have "saw-like" edge.

*Palps:* Short and stout, coxa smooth, trochanter as usual, femur shorter than cephalothorax; pedicellate, inner margin almost straight at base, then suddenly concave to tip, outer margin evenly but not strongly convex; tibia broad, pedicellate, suddenly enlarging on inner side near base, outer margin evenly convex. Trochanter, femur, tibia strongly granulate and sparsely covered with these "saw-like" hairs.

*Hand:* Broad as it is long, greatly swollen on inner margin near base; fingers slightly curved and as long as the hand.

*Mandibles:* Small; spinnerets small and transparent; serrula attached throughout the length of the moveable finger.

*Legs:* The two anterior legs with trochantins; legs covered with many hairs.

This specimen was found on the window pane of the Pomona College greenhouse. A fly (*Musca domestica*) lit on the pane and the pseudoscorpion caught its legs and clung while the fly crawled about. This is the only one of its kind that has been found.

*Atemnus hirsutus* Banks

Described by Banks in this number of the Journal. Only one specimen of this species was taken. This is the species found nearest the ocean. The broad hand is quite evident. Found ten feet from the ocean, among stones, at Laguna Beach.

*Obisium macilentum* Simon

*Description:* Pale yellowish brown, legs paler; hard part shining; cephalothorax one-fourth longer than broad. Sides parallel; mandibles about one-half the length of the cephalothorax; pedipalps very long and slender, with long, fine, scattered hairs. Femur as long as the cephalothorax. Fingers longer than hand.

*Habitat:* Claremont.

*Ideobisium threveneti* Simon

*Description:* Length of animal, including mandibles, 4 mm.; length of palps, 3.5 mm.; length of abdomen, 3 mm.; length of claw, 1.5 mm. Color—Cephalothorax and palps, dark reddish brown; abdomen, lighter than cephalothorax; legs, pale yellow.

*Cephalothorax:* As long as it is broad, upper margin truncate, sides nearly straight, lower margin straight; no suture; four distinct eye spots; eyes on each side almost touch each other.

*Abdomen:* Elongate, three times as long as it is broad; scuta entire.

*Palps:* Coxa smooth; trochanter small; femur long, outer edge almost straight, inner edge slightly convex; tibia short and stout, pedicellate, convex on inner and outer surface.

*Claw:* Not large; finger as long as hand and not curved very much; hand, broad, evenly convex on inner and outer edges.

*Legs:* Lack trochantins, III and IV stouter than I and II; mandibles large; serrula not attached throughout length of moveable finger; spinnerets long and transparent.

*Habitat:* Claremont, Ice House Canyon, under leaves.

*Ideoroncus obscurus* Banks

*Description:* Length of animal, including mandibles, 3 mm.; length of pedipalps, 3 mm. Color—Cephalothorax and pedipalps dark yellow brown; abdomen and legs very light yellow.

*Cephalothorax:* A little longer than broad; front margin slightly truncate, rounded; sides so slightly convex as to be almost straight; lower margin slightly recurved; no transverse sutures; one pair of eyes.

*Abdomen:* Elongate and slender; scuta entire; both abdomen and cephalothorax with a few simple scattered hairs.

*Palps:* Long and slender; coxa smooth; trochanter lacks large protuberance of many of the Cheliferidæ; femur hardly as long as cephalothorax, very slender and not pedicellate; tibia shorter and broader than femur, pedicellate, convex on inner edge, only slightly so on outer edge; trochanter, femur, and tibia covered with short, stout simple hairs; claw long and slender; finger little longer than hand, and only slightly curved; hand twice as long as broad; hand

and claw covered with long, simple hairs; mandibles large, serrula attached only at base; spinnerets long and transparent.

*Legs:* The femur and tibia of the first two pairs of legs rather stout; no trochantins; covered with simple hairs.

*Habitat:* Found in oak trees in the wash around Claremont.

This differs slightly from that described by Banks in that:

1. The upper margin of the cephalothorax is not rounded, but truncate.
2. The fingers of the claw are not shorter than the hand.
3. The femur and tibia of the first two pairs of legs are not stout.

*(Contribution from the Zoological Laboratory of Pomona College)*

# Preliminary Notes on Some Marine Worms Taken at Laguna Beach

W. F. HAMILTON

During the summer of 1914 I made a collection of some 230 bottles of annelids. It was thought best that I should publish a list of the families and of such species as I have succeeded in identifying.

## Polychaeta

### Syllidæ

Are quite abundant among the finer sea mosses.

*Pionosyllis elongata* Johnson.

Found among goose-neck barnacles west of the Laboratory and in sea weed tangles. White with bright red eggs coloring posterior end. Taken June 26, 1914.

Two other forms are common in the finer sea moss.

### Polynoidæ

Are of frequent occurrence on rocks and in seaweed tangles. I have identified four species.

*Halosydna insignis* Baird.

The most common and variable polynoid at Laguna. Color of elytra yellowish gray to bright red. Length from 18 to as much as 47 mm. (contracted).

*Halosydna californica* Johnson.

Less abundant. Similar in distribution. More slender and of a lighter pigmentation.

*Lepidasthenia gigas* Johnson.

This interesting form was taken from a large mass of the tubes of *Vermetus (squamigerus?)* (gasteropod). Heretofore, as far as I know, it has only been recorded as a tube commensal with a large *Amphitrite*. My specimen was not commensal, but was hidden among the mollusc tubes. The color was recorded as a "light, unsaturated yellow, elytra darker yellow, body irridescent below. The setae project only their tips beyond the parapodia, differing only in this respect from

Johnson's figures. I could not find any asymetrical somites, judging from the elytrophores. The elytra were all gone and the specimen was poorly preserved.

*Harmothoe hirsuta* Johnson.

A single specimen 25 mm. long, badly mutilated and in a poor state of preservation was taken in seaweed between tide-marks. Two other species were taken from a similar location, but I have not identified them yet.

PHYLLODOCIDÆ

Three unidentified kinds inhabiting seaweed tangles and holdfasts are in the collection.

EUPHROSYNIDÆ

*Euphrosyne aurantiaca* Johnson.

NEREIDÆ

Are common in the atokous state, and one "heteronereid" was brought in from an unknown location.

*Nereis agassizi* Ehlers.

Specimens which agree closely with figures by Johnson are found very abundantly in seaweed tangles.

*Nereis virens* Sars.

A single specimen was taken in wave-washed sand three miles south of the Laboratory.

There is another species, resembling *Nereis procera* which I have not yet identified.

Two specimens of this beautifully brilliant orange annelid were taken on holdfasts.

EUNICIDÆ

I found few of these, but such as I did find were in burrows in a soft shale ledge or in sand under large stones.

LUMBRICONEREIDÆ

*Lumbriconereis erecta* (?) Moore.

I am not sure of this determination. The setae are identical, but the parapodia are not quite the same as those figured by Moore. The worm is very abundant in the sand under large stones. One or two similar species are common in seaweed and under mussels.

GLYCERIDÆ

Two species of this family were found in the sand under large stones.

*Hemipodia borealis* Johnson.

Found under a large rock, buried in the sand. One very large and active glycerid was found in the same locality. I have not identified it.

CIRRATULIDÆ

Found in the roots of eel-grass, in holes in a soft shale ledge or in the sand under large stones.

*Cirratulus robustus* Johnson.

*Cirratulus spirabranchus* Moore.

Found in abundance in the above places.

TERREBELLIDÆ

Found with the *Cirratulidae.*

*Schmardanella californica* Moore.

Is very abundant in the matted roots of "eel grass."

Two other forms are quite abundant wherever *Cirratulus* is found.

MALDANIDÆ

Found on holdfasts.

*Clymenella rubrocincta* Johnson.

Fairly common.

CHLORHÆMIDÆ

I have a half dozen of these from holdfasts.

SABELLIDÆ

Small sabellids are common in holdfasts and seaweed masses.

SERPULIDÆ

The calcareous tubes of these animals are seen everywhere below half tide, on rocks, in holdfasts and on kelp (spirobis). I have six different serpulids.

HERMELLIDÆ

There are probably two species of this family common at Laguna.

*Sabellaria californica* Fewkes.

This form was found in large colonies in the protected crevasses of cliffs west of the laboratory. The colonies are some twenty feet long, two feet wide and ten inches thick. The tubes are of loosely agglutinated sand and are crowded very closely together with their mouths evenly disposed over the surface of the colony.

Another species lives singly in very hard, thick sand tubes. Some specimens have algæ growing on their opercula.

### Turbellaria

I have three kinds of these "flat worms" in my collection. They are found under partly submerged stones.

### Nemertinea

There are seven different nemertines in the collection. They are recorded from holdfasts, seaweed tangles and from among vermetus tubes.

### Nematoda

There are two or three different marine nematodes in the collection. They are most common in the finer moss.

### Sipunculoidea

There are two kinds of sipunculids, which seem quite distinct. Taken from eel grass roots, from under rocks and mussels.

The specimens were identified from the following papers:

*Fewkes, J. W.* 1899

New Invertebrata from the Coast of California. Bull. Essex inst. xxi, 99-146, pls. 1-7 (2) figs. in text.

*Johnson, H. P.* 1897

A Preliminary Account of the Marine Annelids of the Pacific Coast, with Descriptions of New Species. Proc. Cal. ac. sc. (3), i, 153-198, pls. 5-10.

——— 1901

The Polychætæ of the Puget Sound Region. Proc. Bost. soc. nat. hist., xxix, 381-437, pls. 1-19.

*Moore, J. P.* 1904

New Polychætæ from California. Proc. acad. nat. sci., Philadelphia, 56-484-503, pls. 37-38.

(*Contribution from the Zoological Laboratory of Pomona College.*)

# Barnacles of Laguna Beach

MISS S. P. HUGHES
PACIFIC UNIVERSITY, FOREST GROVE, OREGON

Five species of barnacles were found last summer at Laguna Beach. For the identification of the first two of these, we must thank Dr. H. A. Pilsbry of the Academy of Natural Sciences, Philadelphia.

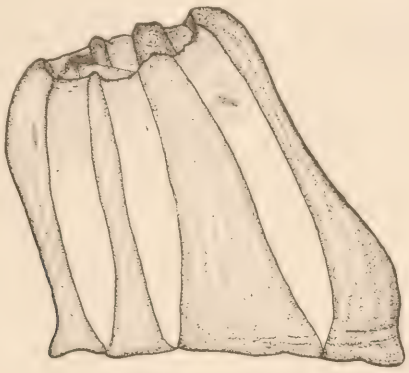


Figure 1

*Balanus tintinnabulum californicus* Pils. Fig. 1

The most common of the acorn barnacles; found abundantly on rocks, mussels, etc. There are six valves or plates; the rostrum, carina, and two latera on each side. These plates are delicately

Figure 2

marked with pink stripes. The connecting pieces are often transversely lined. This is the largest of the common acorn barnacles; the average height is about an inch.

*Balanus nubilus* Darwin. Fig. 2

This is one of the small acorn barnacles, also very numerous on the rocks at tide level. Here the plates, usually six in number, although in some the lateral plates are divided, are closely joined to each other without connecting pieces.

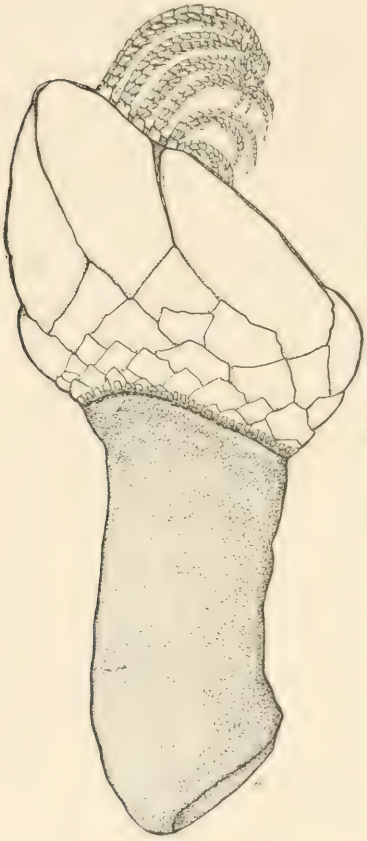


Figure 3

Figure 4

*Mitella polymerus* Sowerby. Fig. 3

This is a very abundant species, and is found in great masses on the rocks near the tide level. It is readily known by the numerous irregularly arranged scales at the base of the capitulum. The valves are usually much worn, and many cases of regeneration have been noted. The peduncle is covered with fine scales.

*Lepas anatifera* Linnæus. Fig. 4

This is a fairly abundant goose barnacle, found in hold fasts of kelp and occasionally on driftwood and floating objects. The size varies from a few millimeters to almost an inch in length. The distinguishing characters are the very fine striations on the valves, the presence of an umbonal tooth on the right scutum, and the proximity of the base of the carina to the scutum. The valves are a delicate pale blue color and the peduncle a deep purplish brown.

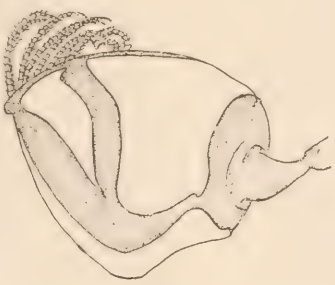


Figure 5

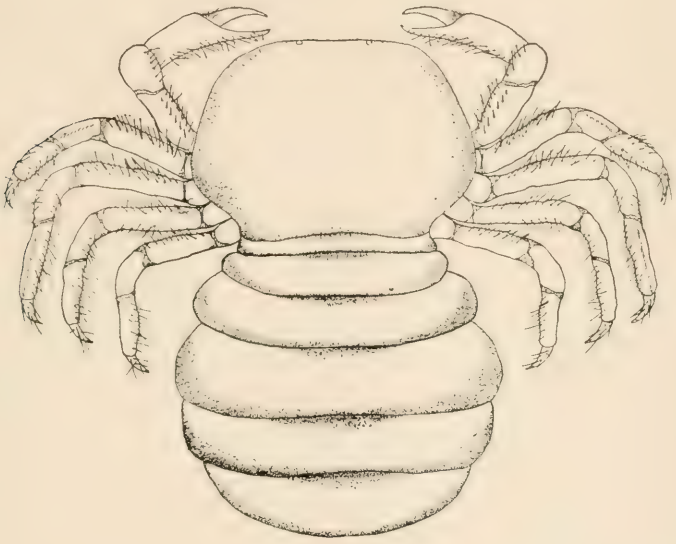
*Lepas fasciculatus* Elis and Solander. Fig. 5

Two specimens were found by Mr. Lichti upon the beach at Green Bay, Laguna Beach, in September of this year. Others have been collected from the Laguna region.

It is a light pelagic form, with paper-like plates and angularly bent carina, with a prominent umbo.

# The Blind Crab Found at Laguna Beach

A number of individuals of the species *Fabia subquadrata* Dana have been found from time to time at Laguna Beach living within the shells of the largest mussels of the species *Mytilus californianus*



Cor., and probably also *M. bifurcatus* Cor. The drawing, enlarged twice, is by Edmund Stone of Pomona College.

*(Contribution from the Zoological Laboratory of Pomona College)*

# The Action of Simple Reagents on the Ganglia of Arthropods

WILLIAM A. HILTON

The ganglia of centipedes and especially those of isopods (*Porcellio*) were removed, placed in various fluids, sectioned and stained. The ganglia were either taken from the decapitated animals and placed in the various reagents or they were first fixed in boiling water and then placed in the fluids. All the specimens were treated alike after remaining for a time in the first fluid, all were carried through the alcohols, cleared, etc., sectioned, stained in eosin and methylene blue and mounted.

Similar experiments are being carried on in this laboratory with the brains of mammals. Differences in detail between the two investigations may be due in part to differences in penetration. The cells of arthropods are very near the surfaces of the ganglia.

The general effects of some of the reagents used are given.

*Acetic acid* 10% after fixation with hot water. Cells deep blue, fibers pink. Overstained blue in the fibrous part settles in a uniform deep color. There is a fine network of pink strands outside the cells. Some cells are with vesicles or light spots but most are pink like the fibrils about. The nuclei are a deep uniform blue. In some places all cells seem to take a deep blue color.

*Oxalic acid* saturated solution. Used directly upon the fresh ganglia. Fibers uniform, cells blue, nuclei clear, fibrils well preserved.

*Tannic acid,* 10%, for fixation. Brown, even blue stain in parts. Not good results.

*Pyrogallic acid,* 10%. Uniform deep blue, fibrils seen on the surface.

Stronger acids seemed to act too quickly, unless used in dilute solutions. No marked results.

KOH, 10% and stronger, used after fixation with heat. In some a fine reticulum of fibers or fibrils was shown with a pinkish stain; the cells were not evident.

KCN, saturated solution in water. Direct action on fresh tissues, no detail in cells, fibres pink.

*Potassium Permanganate* after fixation with heat, 5% solution. All deep blue, deep colored fibers, cells not evident, coarse reticulum between spaces.

*"Osmic acid,"* 1% after heat fixation, fibres straight, reticulum only at edges. Center of ganglion dense mass of fibers and fibrils. Cells deeply colored.

The same reagent used as a fixer gave the same general appearance, only more distinct, with less reticulum. Massed fibers in places not separated into fibrils.

*Phenol,* about 10% after fixation with hot water. Pink fibrils, blue centers of cells, difference between cells and fibers not marked. Possibly cell membrane is broken down, as the cells seem continuous at all points with surrounding fibrils. There are a few vesicles in the cells. Nuclei are deep blue, slightly granular or vesicular. Direct action of the reagent gives similar results with more detail in the nucleus; often there is a blue spot in the center of the nucleus and an irregular cell body with pink fibrils that resemble a reticulum in places.

*Chloroform,* used after fixation. Strands of fibrils are clearly marked, cells deep blue, pink at the edges of the cells.

*Chloral hydrate,* about 20% aq. sol. after fixation. Cells less blue or pink fibrils. No detail in the cells.

*Nitrate of silver* before and after fixation with hot water. No details in cells; coarse reticulum in places.

*Potash alum,* saturated aq. sol. After fixation fibers and fibrils pink, cells blue centers, pink margins; no details.

*Strychnine* after fixation, saturated solution. Fibril reticulum a dull pink, open net work not clearly marked. Cells uniform blue, nuclei clear. In an older specimen more detailed reticulum, cells all dark. In this there is a reticulum with large and small holes.

*Copper sulfate,* nearly saturated solution. Used as a fixer. Fibrils well fixed, pink; cells also well preserved; light blue nuclei, darker cell body; a line of deep blue surrounds the nuclei in some. Other cells have a blue spot in the center. There is some indication of tigroid substance in the cell body.

*Pepsin,* sat. aq. sol. after fixation. In cells where the fluid has apparently not acted long, vesicular nucleus, cell body deep blue, nucleus uniformly light, outer processes of all pink. Cells in some places a uniform blue, not clearly marked. In another specimen, all parts are a deep blue, no details, fibrils compact but with some indications of a *very fine* reticulum.

Direct action of pepsin, deep blue, cells not evident, but holes remain where they were. No details.

In comparison with the action of reagents given above and by other methods, a study was made of the fresh ganglia taken directly from the animals and studied in normal salt. Intravitam stains were also tried. Details in the cells were not clearly made out by those methods, but some conditions were determined in the fibers and fibrils.

## Points Suggested by the Experiments

1. In many cases the results obtained by the use of the reagents were about the same whether the ganglia were first fixed in boiling water or not.

2. In nearly every experiment when the cells were not completely destroyed the same structures of cell fiber and fibril were evident. The nucleus was usually blue, the cell body blue to pink. Fibrils pink.

3. Vesicles in nucleus and cell body were produced by several of the reagents.

4. The fibrils which make up the mass of the cell and large parts of the nerve trunks as well as central portions of the ganglion are quite resistant to reagents of all kinds. They may be found in practically all of the specimens, although they seem to be differently disposed in various preparations.

The vesicular appearances or more pronounced reticular arrangements are produced by reagents. This is clearly seen when comparison is made with the fresh and probably living ganglion and fibers. The fresh strands in nerves and connectives are straight and parallel, while in certain fixed ganglia the strands are irregular, often massed in such a way as to cling at one place and hang free at another, forming a reticulum, as strands of hair or rope would when wet and partly separated here and there. Of all the single reagents tried osmic acid, both before and after boiling in hot water, gave the least distorted picture of fibers and fibrils.

5. Tigroid substance was seldom seen in a typical distribution, although blue staining material might be concentrated in one or another part of the cell body.

*(Contribution from the Zoological Laboratory of Pomona College)*

# Some Points in the Nervous System of a Large Deep Water Crab

WILLIAM A. HILTON

During the summer of 1914 several living specimens of the large crab *Loxorhynchus grandis* Stimp. were obtained at Laguna Beach. One of these was kept for some time in a tank of sea water, and its general movements were observed as it walked about on the bottom or attacked the sharks or other fish in the aquarium. Its movements were slow and its senses seemed not very acûte in this situation.

A gross and microscopical examination of the nervous system gave much the appearance of these organs in other decapods, but the remarkably small size of the brain or head ganglion was especially noticeable. The nerves connected with this ganglion were long and slender. The optic was large, the tegmental a little smaller and the first antennal about as large as this last. Closely associated with the optic was the small oculomotor, and near the connectives the small second antennal. Other small nerves were connected with the brain, whose courses were not traced, including a pair of small frontal nerves.

The connectives with the thoracic-abdominal ganglion were long and slender, with each its small ganglion a short distance from the brain. A cross connection between these connectives was not seen. It may have been broken in the dissection.

The thoracic-abdominal ganglion has many nerves connected with it, as shown in the figure; the largest of these were traced to the legs and upper thoracic appendages. The legs are large and heavy and the nerve trunks in them are large; their combined bulk would probably be many times that of the ventral ganglion.

So far as studied, the internal arrangement of tracts and cells does not differ materially from the classic descriptions of Bethe in another species. One thing especially noteworthy is the fact that the nerve cells do not seem especially large, nor are the large ones numerous.

The nerve cells and fibers were studied in preparations fixed in Flemming's fluid and stained with iron hematoxylin. As in forms previously studied, the general structure of the ganglion in a way duplicates the structure of the nerve cells, in that a general reticulum forms a framework for the other structures in both. It is hard

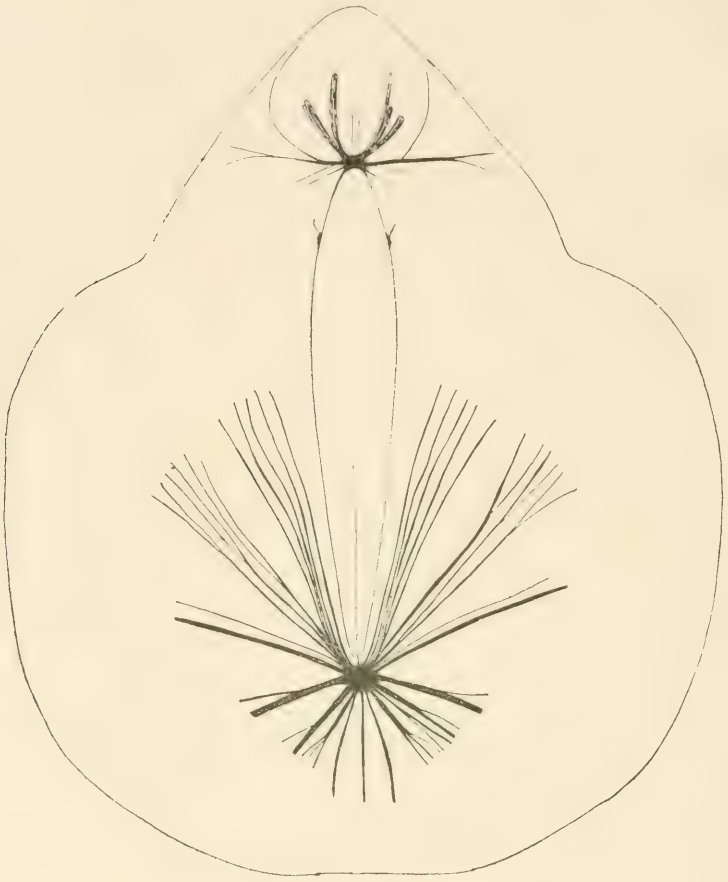
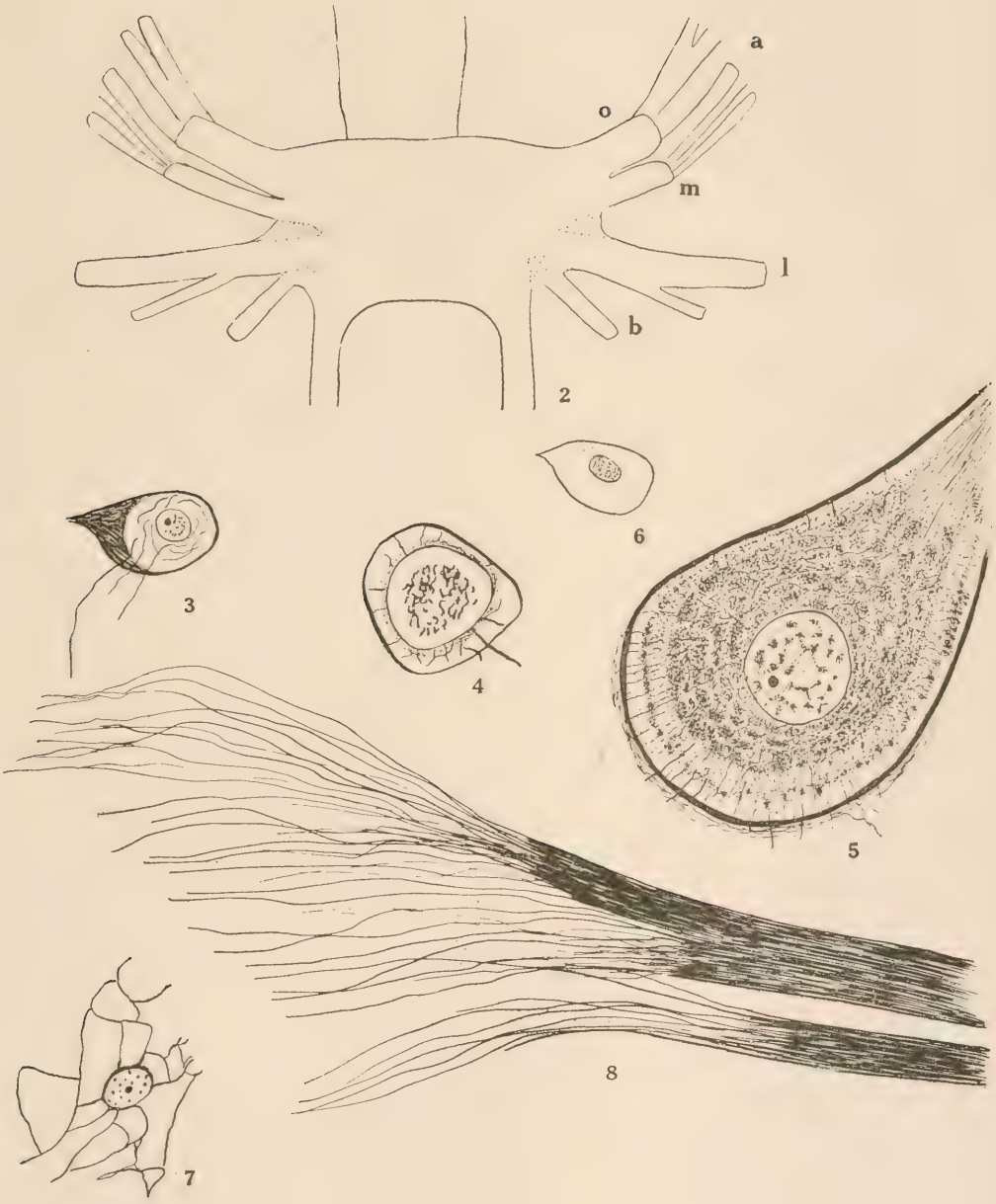


Figure 1

in individual cases to distinguish the supportive structures from the conductive, but the fibers and fibrils in or outside of the nerve cells run in longer straight lines—that is, they do not form so much of a meshwork, although they may branch and intertwine to some degree both within and outside the nerve cells. Large strands or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fibers from nerve cells run as fibers, then divide into smaller masses of fibrils, and at last break up into numerous fibrils. The usual demonstration of nerve cells with their branches as shown by the Golgi or methylene blue methods, I believe, shows only the *larger* and *smaller* branches from nerve cells, and the smallest branches where the fibers break into fibrils are not shown at all.

In this and other arthropods which I have studied, it seems to me to be quite characteristic of the nervous system that many parts show fine fibrillæ more clearly than they are seen in vertebrates. This may in part be due to the nature of the insulating and supportive apparatus. As in *Carcinus,* described by Bethe, the optic tract enters the mesal side of the globulus and splits up into smaller and smaller parts, and is at last lost in the minute network of fibrils and supporting substance. Large bundles from the outside may be seen as dark masses here and there. These last are held in place in the section by many connecting strands which join the fibers from all sides. Some may be conducting fibrils, but it is hard to distinguish these from supportive. Probably most of the conducting fibrils leave at or near the termination of the thicker part of the fiber. The denser parts of the nervous system of this and other arthropods, such, for instance, as the material of the globulus, are composed for the most part of ultimate fibrillae whose relationships at these points can only be conjectured at present because of their minuteness, their great abundance, and because of the intermingling of supportive or other materials of several little understood sorts. An extensive comparative study of these denser masses with various reagents should yield some interesting results.

Tigroid substance, mostly in the form of dots and flakes, was recognized, but not studied by special stains. The cells are surrounded by a dense capsule of connective substance, and in some cases the peripheral zone of the cell next the capsule is light. In some, this light zone is speckled with dark dots or lines. Some of these may be the ends of fibrillæ—in fact, some fibrils were traced —others may be tigroid substance, or possibly the bodies recognized by Poluszynski in some Crustacea, although his are stained by other methods.

## PAPERS MENTIONED

*Bethe, A.* 1898

Das Nervensystem von Carcinus maenas. Arch. f. Mic. Anat. Bd. 51.

*Poluszynski, G.* 1911

Untersuchungen über den Golgi-Kopsch'schen apparat und einige andere Strukturen in dem Ganglionzellen der Crustaceen. Bull. Acad. Sc. Cracovie.

Figure 1. Outline of the cephalothorax of *Loxorhynchus,* showing the position and size of the nervous system. One-half natural size.

Figure 2. Brain of *Loxorhynchus* from above. ×10. o, Ocular nerve; m, oculomotor; t, tegmental nerve; a, first antennal nerve; b, second antennal; c, connective.

Figure 3. Nerve cell with fibrils from the brain. ×900.

Figures 4 and 5. Nerve cells near each other in the brain fibrils are shown. ×900.

Figure 6. Neuroblast from a doso-median mass of the brain. ×900.

Figure 7. Neuroglia cell with branches from the brain. ×900.

Figure 8. Two fibres breaking into fibrils. From the brain. ×900.

*(Contribution from the Zoological Laboratory of Pomona College.)*

# Caprellidæ from Laguna Beach

R. LA FOLLETTE

This paper is a preliminary article on the Caprellidæ of Laguna Beach, and deals with species that have so far been identified. Because of great variation, due to age, it is very difficult to place the different forms.

## *Caprella geometrica* Say

Mayer places *C. geometrica* as one of eighteen or twenty varieties of the species *acutifrons,* but I have thought it best to follow some of the other writers and use *geometrica* as the species name, as my specimen closely resembles the species which seems to be *C. geometrica* in several accounts.

The specimen here described is an adult male. The peræon (Plate I, Fig. 1) is robust and covered with many blunt tubercles. In this respect it varies from the specimens described by others who say the peræon is smooth. The young are comparatively smooth and develop tubercles on the caudal segments first. Cephalon furnished with a sharp anteriorly directed dorsal tooth. First segment shorter than the second, which is triangular in shape; third and fourth broad and a little shorter than the second; fifth, sixth and seventh each growing smaller respectively and truncate at the tip. Antennæ, stout; superior pair not half as long as the body, first joint short and twice as thick as the second but only half as long, third joint shorter than first; flagellum as long as the peduncle and composed of 15 or 16 joints, inferior pair extending to about the middle of the flagellum of the superior, joints long and narrow.

First gnathopod (Fig. 2), attached far forward, convex in shape and tapering slightly toward the finger, which was long as the palm and narrow; palm armed with tooth-like spine at the base and many hairs. Second gnathopod (Fig. 3), attached just posterior to the middle of the second pereiod, basal joint short and thick, not half as long as the palm; inner margin of the hand concave, armed with a tooth on the dorsal lobe and a broad, truncate tooth near the base of the finger, as well as numerous hairs; finger sharply con-

cave on the inner margin for about half its length. Branchia nearly round. Third, fourth and fifth peræopods (Fig. 4) similar in structure, short, stout, and armed with stiff hairs; hand nearly as long as rest of the extremity; palm broad and armed with numerous hairs, inner margin slightly concave, with two serrate teeth at the base.

Length of specimen, 13 mm.

Color varying from a bright red to white.

Several specimens taken at Laguna Beach the latter part of July, from the Rhodophyceæ on the rocks.

The young of this species were very abundant at Laguna Beach, and I will give a short description of one because of the great variation from the adult. Plate II shows a young male with the antennæ inverted showing the setæ on the ventral side. The first five segments are of nearly equal length; peræon smooth; superior antennæ nearly half as long as the body, with inferior nearly as long as superior; flagellum with six to nine joints. Maxillipeds (Plate III, Fig. 5) with inner plate reaching apex of first joint of palp, armed with two teeth and spines; outer plate reaching apex of second joint of palp and armed with three small teeth. Upper lip (Fig. 6) bilobed, finely ciliated. First maxillæ (Fig. 7) two-jointed, palp and second joint armed with spines. Second maxillæ (Fig. 8) armed with a few hairs on the tip. Mandible (Fig. 9) has cutting plate made of five strong, unequal teeth; teeth of secondary plate nearly equal. First gnathopod attached far forward, triangular in shape and fringed with hairs. Second gnathopod (Fig. 11) attached the same as in adult, palm convex on inner margin, instead of concave as in adult, and armed with two small teeth near inner margin at the base; finger is concave and uniform in outline.

*Caprella septentrionalis* Kroyer

The specimen here described differs slightly from those described by Mayer, Holmes, Sars and others, yet I do not think the differences great enough to demand the naming of a new species.

The peræon (Plate IV, Fig. 12) is comparatively smooth, first two segments long, as long as the rest of the body; cephalon angularly produced in front into a very short, blunt spine. Figure 13

shows a specimen with a body somewhat broader. The superior antennæ are about half as long as the body, first joint broader than second, but shorter; second joint longest of all; third longer than first, and narrower than second; flagellum shorter than the peduncle and made up of about twelve joints. Inferior antennæ slightly shorter than the peduncle of the superior. Mandible (Fig. 14) cutting edge denticulate, with five irregular teeth, spine row having three large, feathery spines; molar tubercle strong and prominent. First gnathopod attached far forward, against the maxillipeds; hand triangular, fringed with hairs on the inner margin and one spine tooth near the base. Second gnathopod (Figs. 15, 16) attached near the posterior extremity of the second pereiod, basal joint nearly as long as the hand, inner margin of hand lying in a straight line and armed with two teeth near the base of the palm, one on the lobe and the other to one side. Another long tooth is near the base of the finger and is separated from a large, broad tooth by a deep suture; inner margin of the finger irregular. Third, fourth and fifth peræopods are similar in structure and not as stout as those of *C. geometrica;* hands powerful and armed with three clumps of spines on small prominences; differing in this respect from those described by Mayer, Sars and others in that they lack the pair of serrated spines at the base of the palm. Finger stout and half as long as the palm.

Length of specimen, 12 mm.

Color white or flesh color.

The specimens were collected during the latter part of July at Laguna Beach, from the seaweed in the inner tide pools.

### *Caprella æquilibra* Say

The peræon (Plate IV, Fig. 12) is comparatively smooth, with the cephalon devoid of a horizontal spine; the first three segments are long and narrow, of nearly equal length, the fourth a little longer than the third, the fifth twice as long as the sixth and seventh combined. The branchia are ovate in shape and moderate in size. Between the bases of the second gnathopods is a sharp projection (Fig. 13), and on each side another spiniform process pointing anteriorly. Superior antennæ slightly over half as long as

the body, first joint about half as long as the second, but broader; second twice as long as the first, and third a little longer than the first, but narrower; flagellum with sixteen or seventeen joints and about as long as the peduncle. Inferior antennæ reaching just beyond the peduncle of the superior. First gnathopod small, attached far forward, palm triangular in shape, tapering toward the finger, which reaches back entirely over the inner margin of the palm, armed with two sharp spine-like teeth at the base of the palm, and scattered hairs. Second gnathopod (Fig. 14), attached at the posterior end of the segment, basal joint quite short; other joints have their lobes ending in spine-like processes; palm slightly convex on the inner margin, with a spined lobe about a third of the way along, and a blunt tooth two-thirds of the way along separated from a broad tooth by a deep sinus; claw regularly concave; whole gnathopod with but few hairs. Third, fourth and fifth peræopods (Fig. 15) similar in size and structure; palm thick, with two serrate teeth a third of the distance from the base.

Length of specimen, 12 mm.

Color a dark brown to flesh color.

Two specimens taken on a holdfast that was thrown up on the beach at Laguna Beach during July, 1914.

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*(Contribution from the Zoological Laboratory of Pomona College)*

## EXPLANATION OF PLATES

### PLATE I

*C. geometrica* (adult). ×25

Figure 1. Body showing length of segments.
Figure 2. First gnathopod.
Figure 3. Second gnathopod.
Figure 4. Fifth peræopod.

### PLATE II.

*C. geometrica* (young male). ×40

### PLATE III

*C. geometrica* (young male)

Figure 5. Maxillipeds. ×300.
Figure 6. Lip. ×300.
Figure 7. First maxillæ. ×300.
Figure 8. Second maxillæ. ×300.
Figure 9. Mandible. ×300.
Figure 10. First gnathopod. ×175.
Figure 11. Second gnathopod. ×175.

### PLATE IV

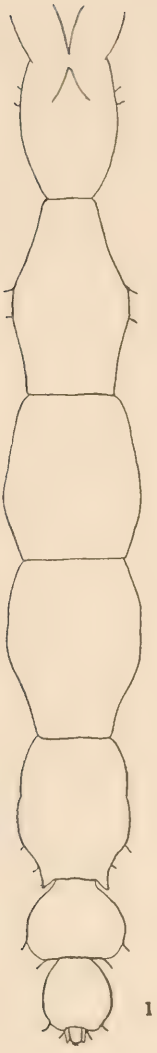
*C. septentrionalis*

Figures 12, 13. Bodies, showing length of segments. ×25.
Figure 14. Mandible. ×110.
Figures 15, 16. Second gnathopods. ×25.

### PLATE V

*C. æquilibra* Say

Figure 12. Body showing length of segments. ×50.
Figure 13. Projection at base of second gnathopod. ×150.
Figure 14. Second gnathopod. ×150.
Figure 15. Fifth peræopod. ×150.



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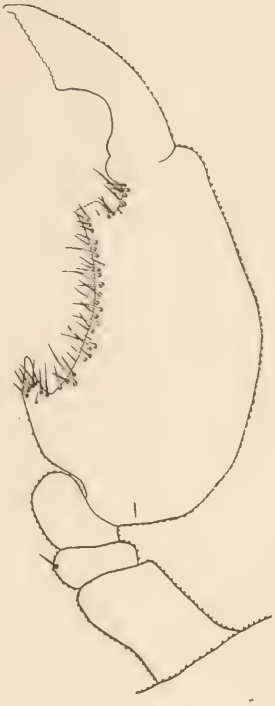

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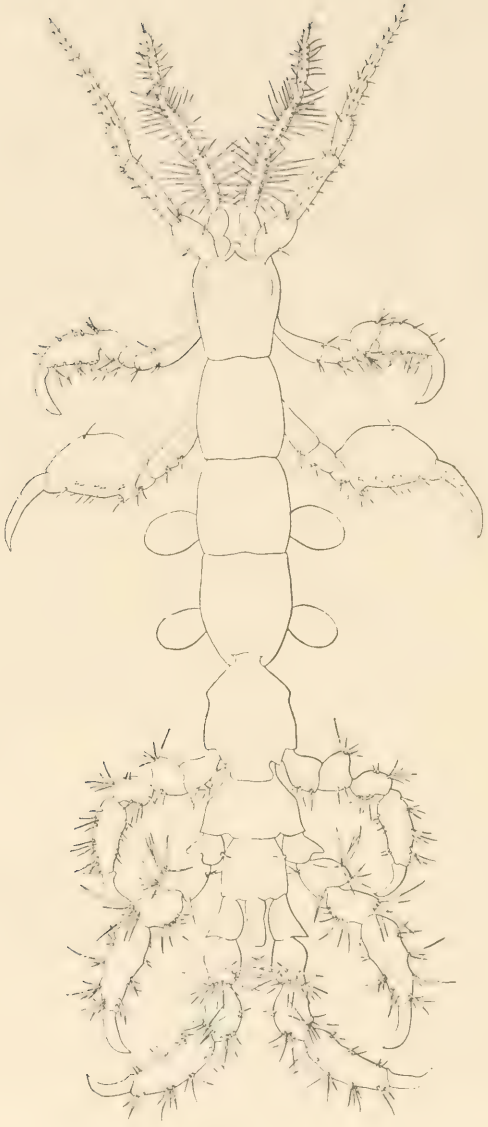
Plate I



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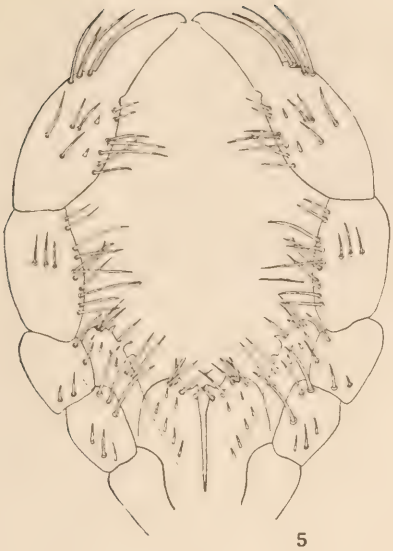

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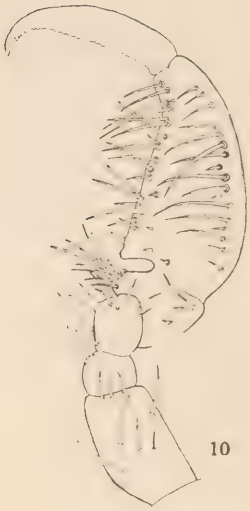

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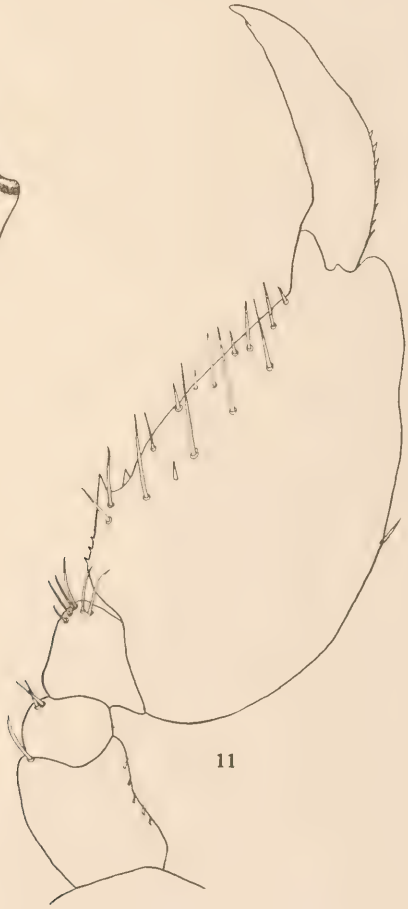

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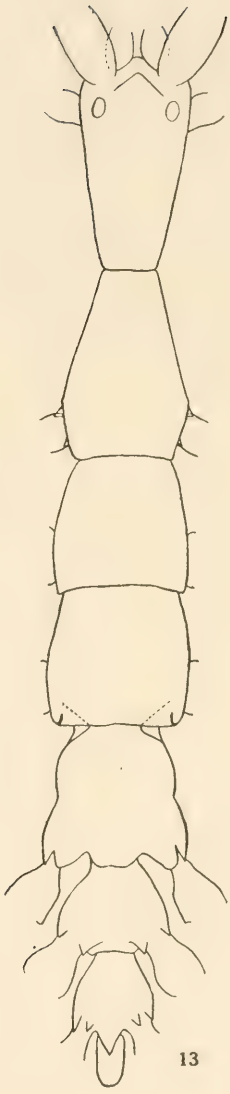
Plate III

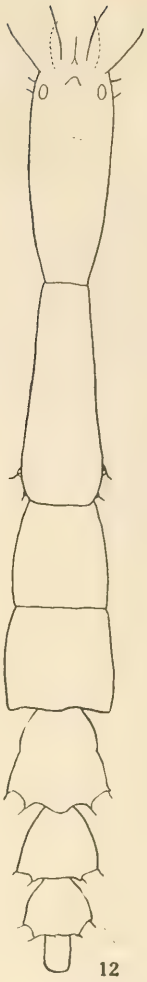






Plate IV

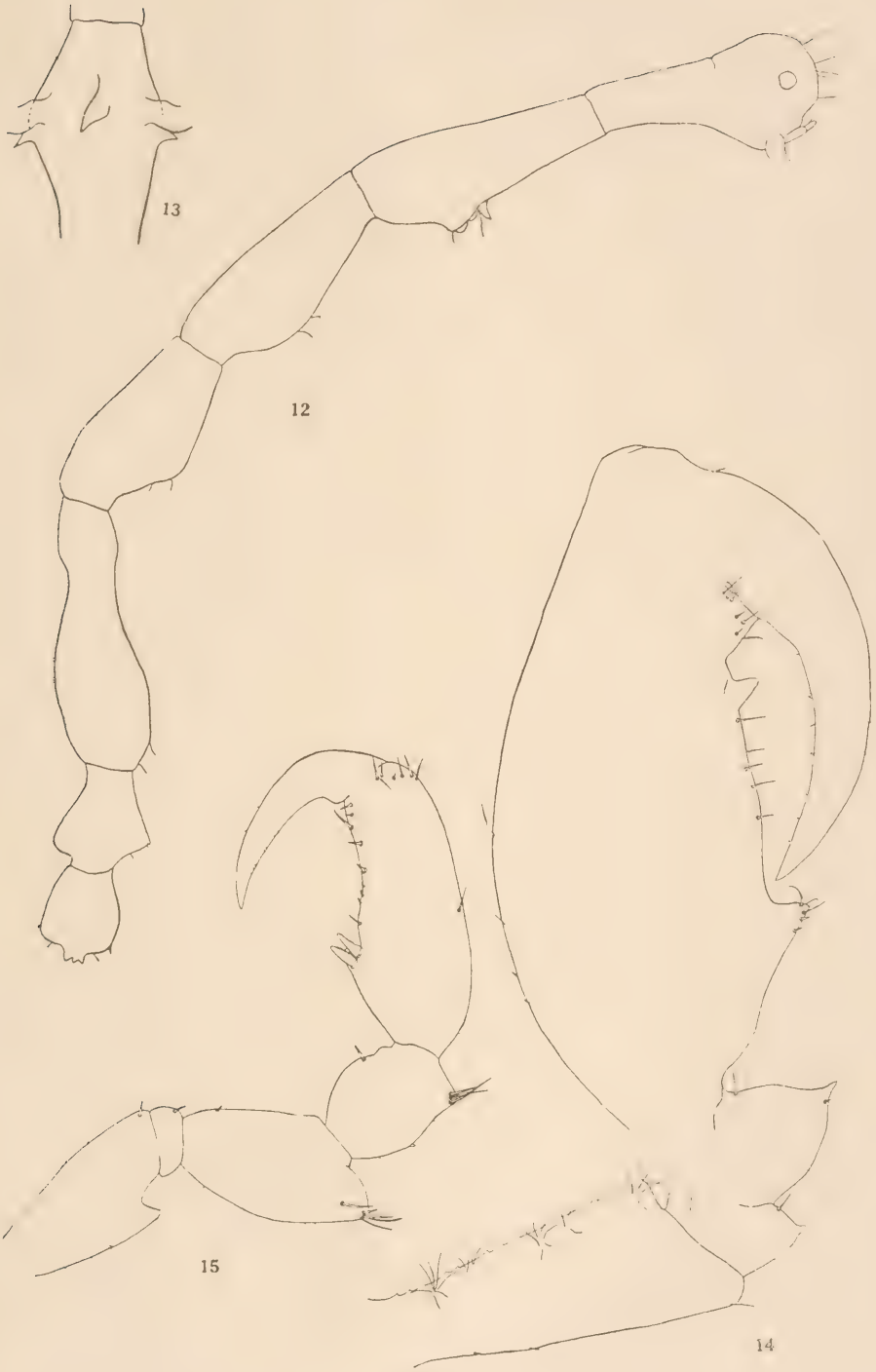



Plate X

# Caprellidæ From Laguna Beach, II

R. LA FOLLETTE

Three genera are included, among them, two new species. Four species were considered in an earlier number of this publication, making a total of seven species of the family Caprellidæ from Laguna. Although the territory accessible at low tide was very thoroughly worked over, yet no doubt several more species could be secured in the deeper water off shore by dredging, and the list of forms is not yet complete.

### *Caprella acutifrons* Latreille

Mayer in his description of the Caprellidæ of the Siboga Expedition, gives as many as ten varieties under the species name *acutifrons*. Among them the variety, *verrucosa,* which includes several specimens from California, is quite similar to my specimens here described, but I think it best to only use the species name *acutifrons* at present.

The peraeon of the male (Plate I, Fig. 1), is covered with several blunt prominences and many short blunt tubercles, the latter as in C. *geometrica.* Cephalon with a short horizontal spine; first segment of body a little shorter than the next three, which are of equal length; fifth about as long as the first; sixth and seventh shorter, respectively. The branchia are ovate, slightly longer than broad and moderate in size. Both pairs of antennæ missing in my specimen. Eyes small and round. First gnathopod small, about one-fourth as large as the second and attached far forward; palm broad, triangular shaped, tapering toward the finger with a few scattered hairs along the border and four tooth-like spines at the base; finger finely toothed along the inner margin. Second gnathopod (Fig. 2) attached about the middle of the second segment, basal joint short and thick, equal in length to the other joints combined; palm broad and toothed as in C. *geometrica;* inner margin slightly concave and armed with a few short hairs and a large prominent tooth at the base and a large flat tooth at the distal extremity; finger short and massive. Third, fourth and fifth peræpods (Fig. 1), similar in

shape and structure, being stout and covered with many short blunt tubercles and a few scattered hairs; palm narrow, concave and armed with two serrate teeth at the base; finger short and stout.

Length of specimen, 12 mm. Color a light brown to flesh color.

One male specimen collected from among the seaweed of the inner tide pools at Laguna Beach in July, 1914.

*Caprella uniforma* n. sp.

The peraeon of the female (Plate I, Fig. 3) is smooth; cephalon furnished with a slight prominence in front directed horizontally. First segment short, about half as long as the second, third, fourth and fifth, which are of nearly equal length; sixth and seventh much shorter, about a third as long as the fifth, the seventh being the shorter of the two. Superior antennæ about half as long as the first two body segments; first joint as long as cephalon and twice as broad as the second joint, which is nearly twice as long as the first; third joint not as thick as the second and one-third as long. Flagellum equal in length to the peduncle and composed of eleven segments. Inferior antennæ but slightly shorter than the superior, furnished with many plumose hairs. Eyes large and round. First gnathopod (Fig. 4) attached anterior to the base of the maxillipeds, large but slightly smaller than the second gnathopod; palm narrow, inner margin finely denticulate, armed with many scattered hairs and four blunt teeth at the base; claw broad and armed with many fine teeth along the inner margin. Second gnathopod (Fig. 5) but slightly larger than the first; basal joint long, longer than the palm; palm narrow, armed with a few hairs and two blunt teeth near the margin, the longer on the margin, and the shorter posterior to it; finger narrow and short. Branchia ovate. Third, fourth and fifth peraepods (Fig. 3), similar in structure and increasing in size respectively, the fifth being nearly a third longer than the third; hand narrow, armed with two serrate teeth at the base and a few hairs; claw short and sharp.

Length 14 mm.

Color, a light brownish green. The male specimens taken were quite similar to the female, including the shape of body segments and gnathopods.

Several specimens taken from a holdfast cast upon the beach at Laguna during July, 1914.

*Æginella hirsuta* n. sp.

In the adult male the peraeon (Plate II, Fig. 6) is smooth and devoid of a horizontal spine; first two segments short and of equal length although the second is the thicker; third and fourth equal in length and nearly twice as long as the second; fifth longer than the fourth but not as thick; sixth and seventh a fourth as long as the fifth, decreasing in size respectively. The superior antennæ are only half as long as the body; first joint a little longer than the cephalon; second joint longer than the first but not as thick; third joint only half as long as the second and half as thick; flagellum two-thirds as long as the peduncle and made of 16 segments. Inferior antennæ about as long as the peduncle of the superior and armed with many long hairs on the dorsal surface; flagellum two-jointed. Mandible (Fig. 10) made up of a strong cutting plate with five unequal teeth and a large rounded secondary plate with a few short prominences; several feathery hairs lie between the two plates and the mandible is supplied with a three-jointed palp. The first gnathopod (Fig. 12) is small and attached far forward; palm broad, nearly as wide at the base as the tip and armed with two spine-like teeth at the base and a few scattered hairs; edge finely toothed; claw medium and toothed with many small and a few regular teeth. Second gnathopod (Fig. 7) attached far forward on the second body segment; first joint longer than the others combined; palm long and narrow and armed with a small toothed lobe at the base and another larger tooth a little posterior; margin thickly covered with many long hairs; finger long, curved and also lined with many hairs along the inner margin. Fig. 8 shows the second gnathopod of a younger specimen, 10 mm. long; the palm is thicker, the inner margin not as regular in outline and armed with fewer hairs, while the finger is shorter than in the adult. Fig. 9 is the second gnathopod of a still younger specimen, 7 mm. long; the palm is much shorter and thicker and the inner margin lacks the second spine at the base and has a few blunt prominences at the posterior extremity and but few hairs; the finger is similar in shape to that of the adult. The third, fourth and fifth peraepods (Fig.

11), are similar in shape, being long and narrow; the third is somewhat shorter than the fourth and fifth; hand narrow and armed with a few hairs along each margin and two spine-like teeth at the base; finger long and sharp.

Length of adult male, 2 cm.

Color a light yellowish brown with a few brown spots.

Two adult specimens were taken at Laguna Beach in July, 1914, about a quarter mile off shore while dredging. Several specimens of the young, both male and female (Fig. 13), were collected from among the Rhodophyceæ in shallow pools at low tide. They were dark red in color like the seaweed and resemble the adults in every respect except those mentioned above and the antennæ, the superior pair being but slightly longer than the inferior; flagellum with but six to eight joints; inferior pair reaching to the last two joints of the flagellum of the superior.

*Paedaridium breve* n. sp.

Peraeon (Plate III, Fig. 14) comparatively smooth; cephalon devoid of a horizontally directed spine, and skull-shaped; neck very short; first three body segments of nearly equal length and rather stout; fourth segment about twice as long as the third and narrowing at the caudal end; fifth and sixth segments a little longer than the fourth and about half as broad; seventh about one-fourth as long as the sixth and narrow. Superior antennæ (Fig. 16), only slightly longer than the first body segment; first segment short and stout; second about twice as long and narrower; third shorter than the second; flagellum made up of two joints and armed with a few short hairs at the distal extremity. Inferior antennæ (Fig. 16) devoid of motor seta, nearly as long as the superior and fitted with a two-jointed flagellum. Mandible (Fig. 15) with a three-jointed palp armed with a few hairs; six irregular teeth on the mandible plate, three of which are large, the first being split into two divisions. Branchia on the third and fourth segments, ovate. Eyes small and round. First gnathopod (Fig. 17) attached far forward on the first segment; first joint long and narrow, longer than the palm; wrist broad; palm similar in shape to that of the second gnathopod and armed with two heavy spines at the base and numerous hairs

along the margin. Second gnathopod (Fig. 18) twice as large as the first and attached far forward on the second segment; first joint as long as the hand; palm broad and slightly convex on both margins, armed with three short, heavy spines on a slight prominence at the base and many hairs along the inner margin; finger reaching to the spiny prominence on the palm and uniform in outline. First peraepod attached at the base of the gill on the third body segment and made up of three small joints. Second peraepod attached at the base of the gill on the fourth segment and composed of but one short segment. Third peraepod (Fig. 14) attached just posterior of the center of the fifth body segment and composed of three segments; the first two of equal length, third very short; total length 1 mm. Fourth and fifth peraepods (Fig. 14) normal, having proper number of segments and of nearly equal length; palm and claw as long as the other segments of the peraepod combined; palm narrow, armed with a few regularly placed spines; finger but slightly curved.

Length 3 mm.

Color light pink to white.

Several specimens collected from the seaweeds at low tide, Laguna Beach, July, 1914.

*(Contribution from the Zoological Laboratory of Pomona College)*

## EXPLANATION OF PLATE I.

C. *acutifrons*

Figure 1. Body showing length of segments and fifth peraepod ×16⅔.
Figure 2. Second gnathopod ×50.

C. *uniforma*

Figure 3. Body of female showing branchia and peraepods ×16⅔.
Figure 4. First gnathopod ×50.
Figure 5. Second gnathopod ×50.

## EXPLANATION OF PLATE II.

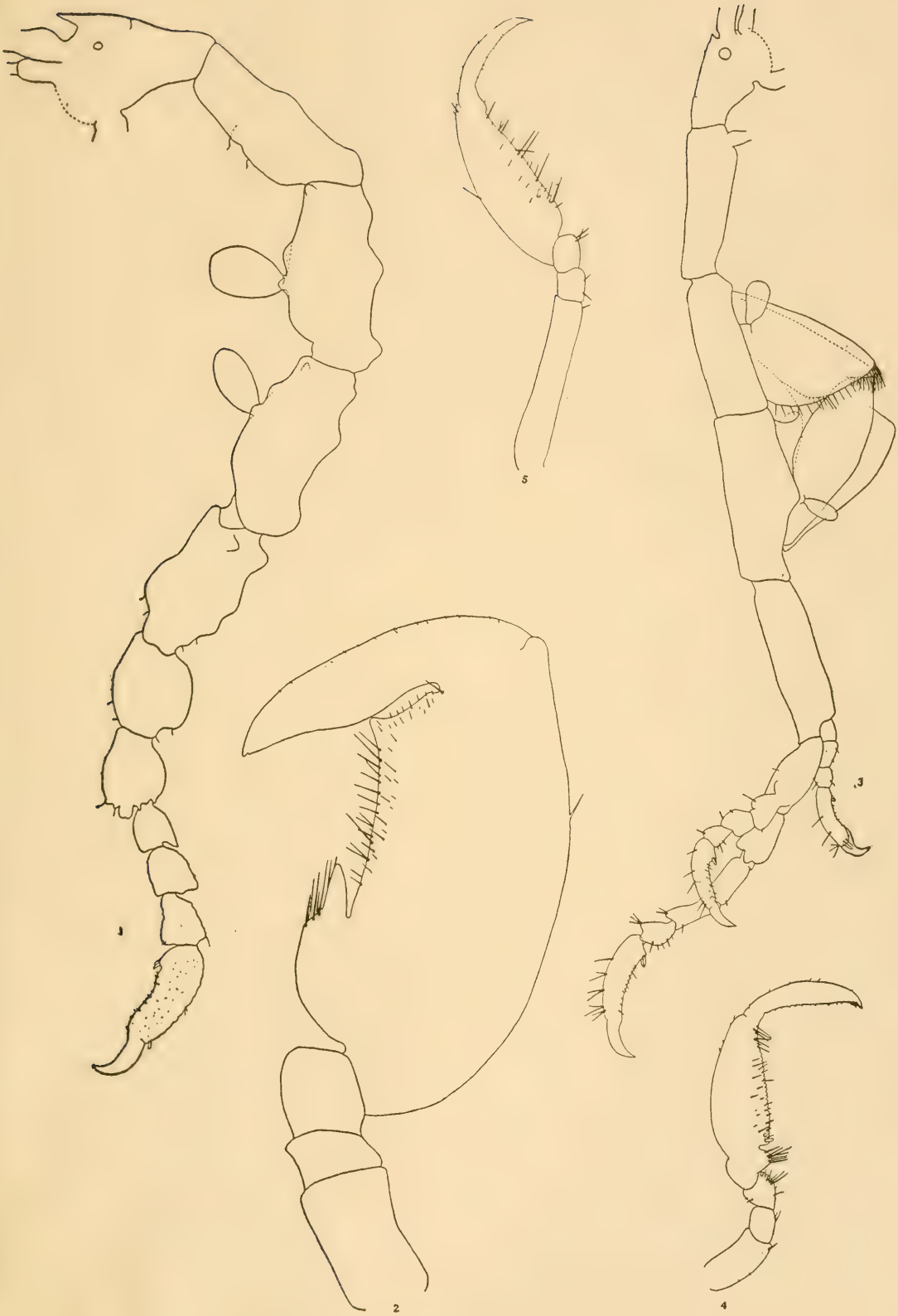
A. *hirsuta*

Figure 6. Body of male ×25.
Figure 7. Second gnathopod of adult male ×25.
Figure 8. Second gnathopod of younger form ×25.
Figure 9. Second gnathopod of still younger form ×75.
Figure 10. Mandible and palp ×300.
Figure 11. Fifth peraepod ×25.
Figure 12. First gnathopod adult ×25.
Figure 13. Body of young female ×75.

## EXPLANATION OF PLATE III.

*Paedaridium breve* n. sp.

Figure 14. Body showing length of segment and peraepods ×25.
Figure 15. Mandible ×300.
Figure 16. Antennæ ×25.
Figure 17. First gnathopod ×75.
Figure 18. Second gnathopod ×75.
Figure 19. Fifth peraepod ×75.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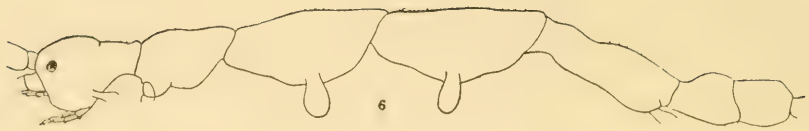
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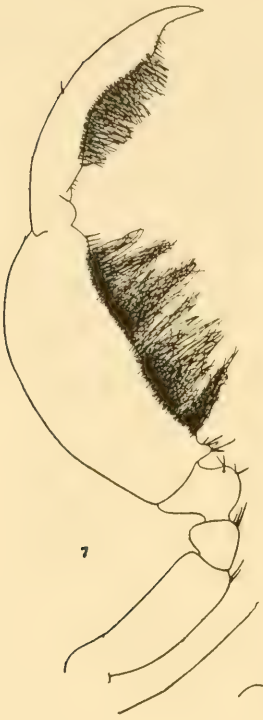
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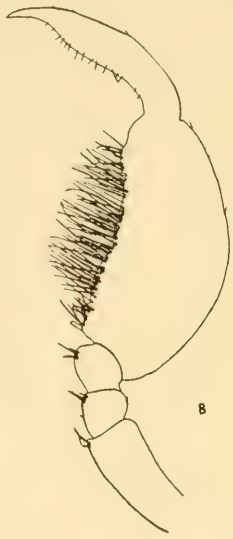
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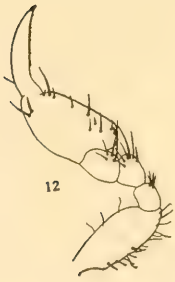
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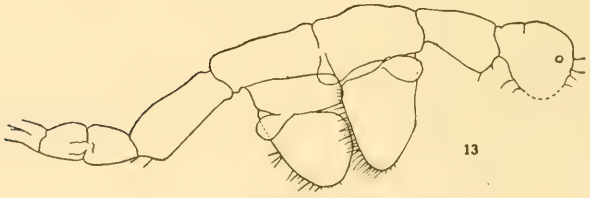
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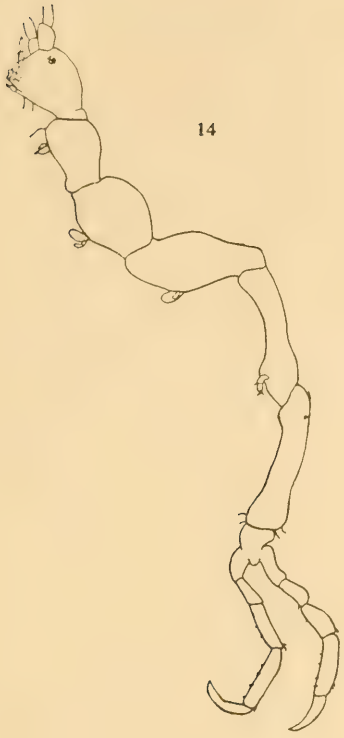

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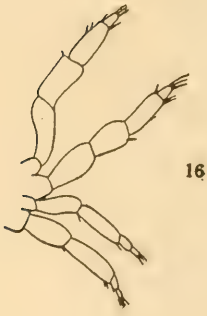

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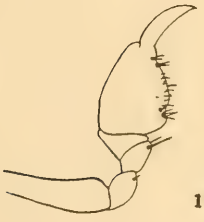

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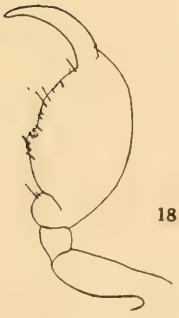

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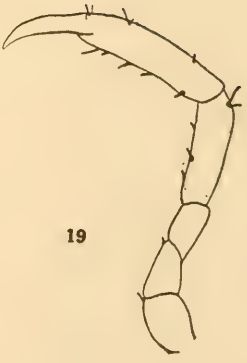

19

# A Remarkable New Brittle Star

HUBERT LYMAN CLARK

OPHIOCRYPTUS gen. nov.

ὄφις=*snake* (a very common prefix for genera of brittle stars)
κρυπτός=*concealed;* in reference to the concealment of the disk scales and arm plates by granules.)

Disk covered with rather swollen plates, which are either completely concealed by coarse granules or are bare at the middle only. Upper surface of arm more or less covered, with a coat of granules. Oral shields (except madreporite), adoral plates and oral plates, completely concealed by a coat of granules continuous with that which covers the interbrachial areas. Arm spines short and thick. Genital slits, four in each interbrachial area. Tentacle scales 2, well developed.

Type-species: *Ophiocryptus maculosus* sp. nov. (see below).

This genus is nearly related to Ophioncus, described by Ives (1889) from the "West Coast of North America." The complete concealment of the mouth plates by granules and the large amount of granulation on the arms are important differences, however, and prevent assigning the present species to Ives' genus. Moreover the bareness of certain disk-plates at their center while the radial shields are entirely concealed is an odd feature. Koehler has recently described and figured (1914, Bulletin 84, U. S. Nat. Mus., p. 8; pl. 2, figs. 1,2) an interesting little ophiodermatid from the Bahamas, which he considers a young Ophioderma. His admirable photographs show however that it is very close to the species I am here describing, but differs in having longer arms and bare radial shields. In the last particular and in the uniform granulation of the disk, it resembles Ophioncus. As it has six arm spines I suggest that it may well be called *Ophiocryptus hexacanthus.* The type is U. S. Nat. Mus. Ac. No. 41471, and is from Green Cay, Bahamas.

OPHIOCRYPTUS MACULOSUS sp. nov. (*maculosus* = spotted)

Disk 6 mm. in diameter; arms 9 mm. long, flattened, especially near tip, of 17 visible joints. Disk evidently covered by rather

large, somewhat swollen plates, 80 to 100 in number, counting the small ones, but excepting the central portion of 12-15 of the largest, these are all concealed by a fairly uniform coat of granules, about 50-75 per sq. mm. No radial shields can be distinguished. The coat of granules extends along the upper surface of the arm to the very tip and covers also most of the surface of the basal side arm plates; many of the upper arm plates are bare at the center, but others are completely hidden. Interbrachial areas below covered by a uniform coat of granules which extends clear to the very jaw tips, completely concealing the oral shields (except the madreporite, which is largely bare), the adoral and the oral plates. Oral papillæ, 10-12 on each side, large and thick, not at all, except the distalmost, squamiform. Those near the tip of the jaw and the penultimate are the largest, while the middle ones are somewhat smaller; they are roundish and blunt, twice as long as thick. First under arm plate small, triangular; succeeding plates longer than wide, basal ones in contact, much wider distally than proximally and with distal margin strongly convex and a little swollen; they are somewhat hexagonal, but the three proximal sides are very short, while the distal lateral sides are long and concave. Side arm plates moderately large and projecting; each carries a series of five short, thick, almost conical, subequal spines, scarcely half as long as a joint; the spine-ridge is near the middle of the plate and the spines stand more or less straight out from it. Tentacle scales two, very large and scale-like; on the terminal joints there is only a single scale. Color (dried) dirty whitish, brightest orally; disk spotted with minute brownish-red spots, widely and irregularly spaced. A smaller specimen, preserved in formalin, has the upper surface of the arms quite pink or rose-colored and the spots on the disk are distinctly red.

This very remarkable brittle star was sent to me by Professor W. A. Hilton, who discovered it among kelp "holdfasts" at Laguna Beach, California, July 24, 1914. The holotype is in the collection of the Museum of Comparative Zoölogy, Cambridge, Mass. (Cat. No. 3914), while a paratype remains with Professor Hilton. The resemblance to the Bahamas species, referred to above, is particularly marked in the oral view but in *maculosus* the madreporite is

notably bare, while in *hexacanthus* it is indistinguishable. Seen from above, the smooth, nearly pentagonal disk of *hexacanthus* with bare radial shields, is markedly different from the somewhat swollen disk of *maculosus,* bulging a little in each interradius, covered with more or less lumpy plates and with concealed radial shields. In *hexacanthus* the arms are more than twice the diameter of the disk, while in *maculosus* they are only once and a half the disk diameter. It is to be hoped that further material of both species will soon be secured to throw light on the habits as well as on the morphology. It is particularly important to learn to what extent the granulation of disk and arms is variable. If individual diversity in this feature is very great, a good series of specimens may demonstrate that Ophioncus and Ophiocryptus are identical.

# Pycnogonids Collected During the Summer of 1914, at Laguna Beach

WILLIAM A. HILTON

The collection began on July 9 and a few specimens were obtained as late as November 15. As there are a number of new records as well as some new points in connection with distribution it seemed best to publish this list for the aid of future workers.

At Laguna there are three well defined litoral regions where pycnogonids are found and in some of these they are very abundant. To a large degree several species are distributed in these regions in such a way as to escape casual observation. Although it is convenient to recognize these three localities, yet it must be admitted that there is some degree of overlapping. The regions are as follows: 1st, under stones at moderately low tides not necessarily far out; 2nd, among coarse polyzoan colonies which are found attached to rock ledges or on the margins of large stones; 3rd, the red sea weed locality, especially among those growing on mussels well out on rocky points.

The specimens were determined by the papers of Cole, Hall and a number of others. As there is some variation in the cephalic appendages and as these are much used in determination, their general character and number of joints are given under the name of each species. Numbers: I for chelifori, II for palpi, III for ovigers.

## Family PALLENIDÆ

### *Pallene californiensis* Hall

I 2 j. chelate, II lacking, III 10 j. Slender body. Twenty-five specimens of these were collected, some young and very small and delicate. The strong jaws of the first appendage are especially noticeable. The body and legs are very light colored. A number of males were obtained carrying the large eggs which are marked in this genus. Almost all of these were found among the white tangled stems and zooids of polyzoans which they closely resembled.

## Family AMMOTHEIDÆ

*Lecythorhynchus marginatus* Cole

I 1, II 9, III 10. In a few cases I seemed to be two-jointed, but this was due to internal structures and not a true joint. III in a number of cases had fewer joints than 10; it is possible that these were young or the results of mutilations. This is one of the larger species. The body and legs are of a reddish brown color. Sixty-five specimens were obtained; many of the males bore eggs. They were found among the red seaweeds, especially among mussels well out on the points. Their colors matched those of the red seaweeds with which they were associated; they were seldom found where Caprellidæ were abundant.

*Ammothella tuberculata* Cole

I 3, II 9, III 10 joints. Tubercles on the dorsum, light brown in color. Thirteen specimens were obtained, found usually among the older strongly chitinized polyzoan branches; also found occasionally among similar growths on mussels.

*Ammothella bi-unguiculata* var. *californica* Hall

I 3 j. chelate, II 9, III 10. Straw colored; found among mussels. Two specimens found, neither with eggs.

*Ammothella spinosissima* Hall

I 3, II 9, III 10. Three large branched spines on the back. Branched spines on the legs. This very interesting pycnogonid was found under stones. Four specimens were obtained; two of these bore eggs. The long spines and hairs catch sand grains and may make the individuals look like little heaps of sand. All were found under stones.

*Tanystylum intermedium* Cole

I 2, II 6-7, III 10. These small white pycnogonids were very abundant among Polyzoa. A few were found wandering from this locality. Sixty-five specimens were collected, many with eggs.

*Tanystylum orbiculare* Wilson

I 1, II 6, III 10. I have some doubt as to this determination. This may be a new species, but it is similar to the eastern form.

Strongly chitinized with ridges of yellowish cuticle between the legs. These were found among the coarser polyzoan stems which they much resembled in shade and form. They were also found among mussels in similar situations. Forty-four specimens were found, a number of the males had eggs.

*Clotenia occidentalis* Cole

I 1, II 4, III 10. Rather strongly chitinized, found among old polyzoan stalks and among mussels. Two specimens.

## Family PHOXICHILIDIIDÆ

*Phoxichilidium femoratum* Cole

I 2 chelate, II absent, III 5. Light brown, among mussels. Two specimens.

*Halosoma viridintestinalis* Cole

I 2 chelate, II absent, III 6. Elongate body, light brown. Three ward. Disc shaped body. This is the smallest pycnogonid at Laguna. Found among the zooids of polyzoan colonies. Twenty specimens, a number with eggs.

*Anoplodactylus californicus* Hall

I 2 chelate, II absent, III 5. First trunk segment projects for- specimens found among mussels.

## Family PYCNOGONIDÆ

*Pycnogonium stearnsi* Ives

I no joints, II none, III 10 joints in male, none in female. Broad thick legs, light brown body. Two found among mussels July 9. One of these was a male with eggs, one a female.

## Family NYMPHONIDÆ

*Nymphon* sp.

I 3 chelate, II 6, III 8—three like this; one as follows: I 2-3, II 4-5, III 5-6. One or both of these may be new species. They were light brown in color and found among the darker stems of polyzoans; one or two among mussels.

In addition to these there were ten or more specimens collected that were not determined, some were immature, others were injured. In all about 250 specimens were collected.

The largest number were of three or four kinds. In spite of some wandering the pycnogonids seemed to resemble their surroundings to a remarkable degree, either in color or lack of color in the body and in the form and shape of the body and legs.

*(Contribution from the Zoological Laboratory of Pomona College)*

# The Central Nervous System of Nebalia

WILLIAM A. HILTON

A number of specimens of *Nebalia bipes* Fab. were fixed in various ways, serial sections were made and stained in Delafield's hematoxylin, carmine and iron hematoxylin. The last stain gave the best results.

The brain is composed of three parts of unequal size. The optic lobes connected with the stalked compound eyes are the largest of the three divisions. Due to the compound eyes this part of the brain is complex. A median longitudinal section through an optic lobe shows an arrangement of cells and fibers as follows: Next the eyes there is a rather thick, dense layer of cells chiefly noticeable because of their nuclei; back from this a smaller crescent-shaped mass of fibers is evident, followed by a zone of crossed fibers and scattered cells. The cross fibers are connected with a central rounded core of fibers which is separated slightly from two other masses. All are largely surrounded by cells.

Cross sections of the optic stalk or lobe give little indication of the several divisions of cells and fibers, the general appearance for most of the distance being of a central core of fibers surrounded by densely packed cells. Towards the junction of the lobes with the brain the cells less uniformly cover the central fibers. After the two lobes approach each other, the masses of cells on either side are massed together but not fused or united across the middle line, although the two lateral parts are closely applied to each other. Dorsally for a short distance, a thin band of cells which may not be functional nerve cells arch over and connect the two lateral halves of the brain, leaving a small cavity just below, which

is continuous with the line of separation between the two sides. Quite a little farther down, the central fibers which are continuous from the optic lobes meet with more ventral fibers which have gradually been making themselves evident, and it is possible to determine two additional masses of nerve fibers. It is at about this level or a little before that the two sides of the brain are fused for a short distance. The more dorsal mass of fibers represents those followed from the optic lobes, the middle fibrous mass is the core of the antennular portions of the brain, the ventral masses represent the centers of the antennal lobes. These masses are connected to the lobe or lobes near them. The middle fibrous portion does not remain distinct for long. Farther down there is but one central fibrous portion which may be called the antennal center. The connectives with the ventral chain of ganglia are without accompanying cells for only a short distance.

The ventral ganglia were found to be in about the same positions as earlier authors have described. There are eleven centers for the thoracic region and six for the abdominal. These thoracic centers are in a sense ganglia very closely connected. There are few indications of distinct right and left halves. The nerve cells in a way correspond to the position of appendages which are attached to this region of the body, but the dorsal and ventral masses of cells are not exactly over each other. The dorsal cell groups are especially interesting. They are found in great masses which overhang in two directions, toward the caudal end and towards the middle line, forming "neural crest" cells which may project so far from the general mass of the nervous system as to be shown as separate clumps of cells in cross sections.

The six abdominal ganglia are well separated from each other and at places show something of a paired nature. The nerve cells are not so numerous and do not project from the general surface. The last ganglion has but a few cells, mostly ventral ones. I agree with Packard, who says that the nervous system is not very complex, although one could learn very little from the figures which he shows to support this conclusion. Of course, there are the rather complex optic lobes connected with the stalked eyes, but these and other parts of the brain are not complicated by the deep

staining masses so characteristic of many arthropods. In no place is the fibrous mass of the brain or ganglia of great complexity. Fibers for the most part run in straight pathways, many connect the brain with lower levels, but possibly less than are usually found because the connectives with the brain are rather narrow. More or less continuous cell masses inclose the brain and upper ganglia. These cells are massed, there are several sizes and the staining reactions differ. In places some cells take a much deeper color.

There are not many indications of cross connections between right and left halves in the lower portion of the nervous system.

One of the most remarkable features of the brain is the failure of the more forward lateral portions to unite across the middle line. Back from the center fusion takes place above, but not at the dorsal surface. For a short distance three parts of the brain may be distinguished although they are largely fused with each other. Back of this the antennal lobes become distinctly separate, and at last end in the narrow connectives which run to the ventral ganglia.

The eleven thoracic ganglia may be determined by the position of the appendages of this region and to some degree also by the location of the nerve cell groups. The six abdominal ganglia are well marked from each other and towards the last the right and left connectives may be determined for the first time in the ventral chain.

Another interesting condition of the nervous system is found in the brain. A slight cavity remains for a time between the two lateral halves of the upper part of the brain in a dorsal position. This space is shut in above by a small mass or line of cells which may not be nerve cells, although they are joined with the brain. It seems as though the two lateral halves of the brain came together leaving a cavity between which they at last bridged over dorsally by the growth of adjacent parts. This suggests a similar formation of a cavity in the central nervous system of vertebrates at an early time.

## SUMMARY

1. The central nervous system consists of the brain of three fused ganglia, the ventral chain of about eleven centers and the six abdominal ganglia.

2. The brain is chiefly made up of the optic and antennal lobes; these are fused at the central portion of the brain with the lobes of the antennules. There is but a short portion of the brain fused from side to side.

3. Although there are connections from the brain to the lower levels these are not great because the connectives are narrow.

4. With the exception of the rather complex optic lobes the nervous system is of simple structure. There are no complex masses of tangled fibers and fibrils.

5. Cells sheath or accompany almost all parts of the central nervous system. They are also massed in projecting lobes or "neural crests" in the thoracic region, where they project caudally and towards the middle line.

6. A central cavity is formed in the central region of the brain where the two lateral halves are united only by a line of cells on the dorsal surface.

7. In spite of the fact that the animals are mature as determined by the germ cells, the nerve cells and nervous system seemed almost embryonic. The masses of cells in places seemed only slightly different from the body cells.

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*(Contribution from the Zoological Laboratory of Pomona College)*

## EXPLANATION OF FIGURES

Figure 1. *Nebalia* from the side. The position of the ganglia is indicated in the drawing. ×12½.

Figure 2. Longitudinal section of the central nervous system compiled from two adjoining sections. Elements of all the centers are shown. The brain is at the upper end.

Figure 3. Longitudinal section through an optic lobe. ×215.

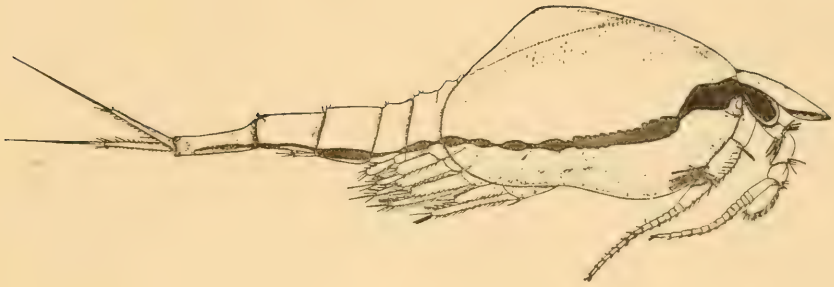
Figure 4. Cross section of an optic lobe. ×215.

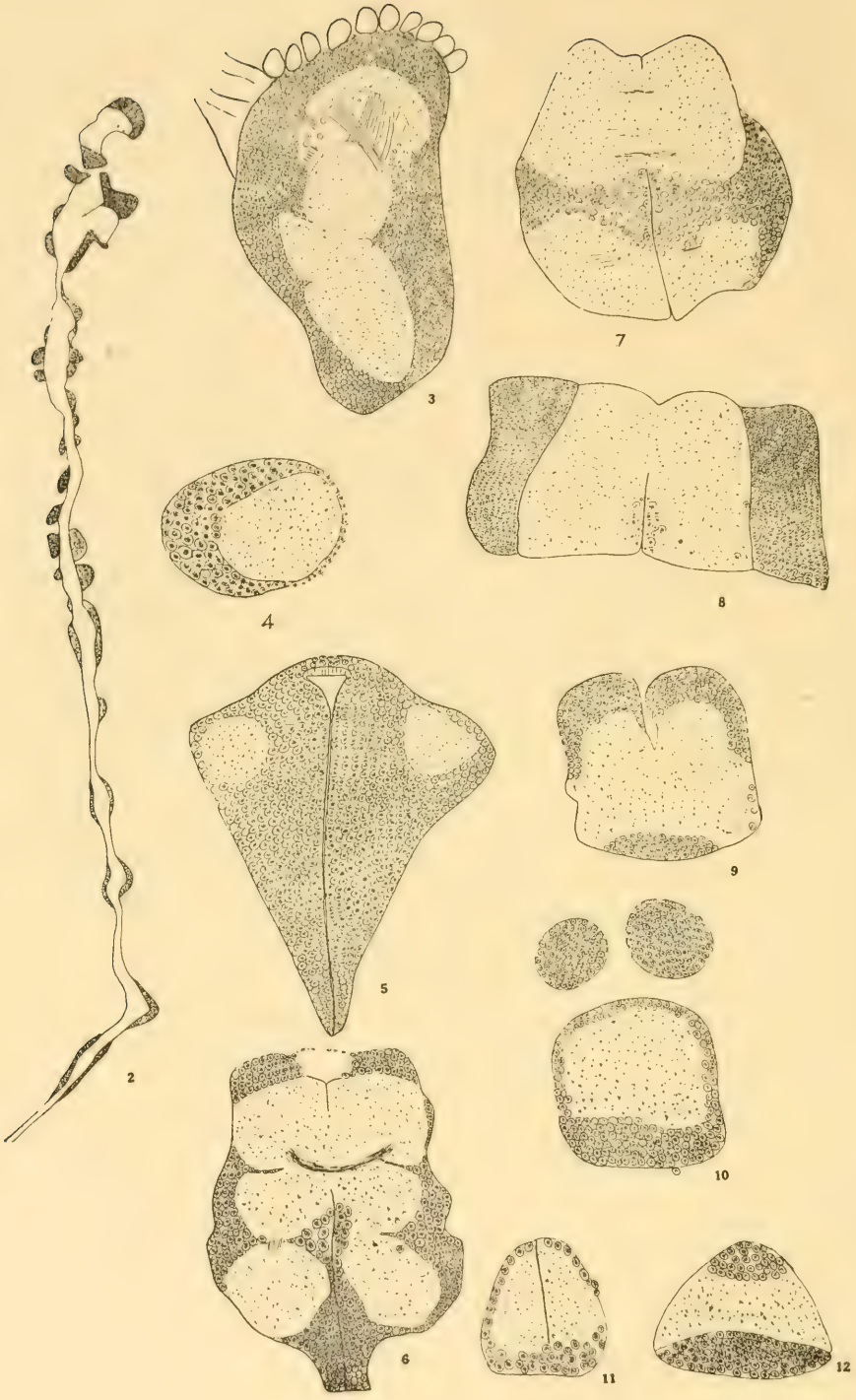
Figure 5. Cross section of the upper portion of the brain. ×215.

Figure 6. Cross section of the central portion of the brain showing centers of fibres. ×215.

Figures 7 and 8. Lower sections through the brain. ×215.

Figures 9-12. Cross sections through ventral regions of the nervous system. ×215.

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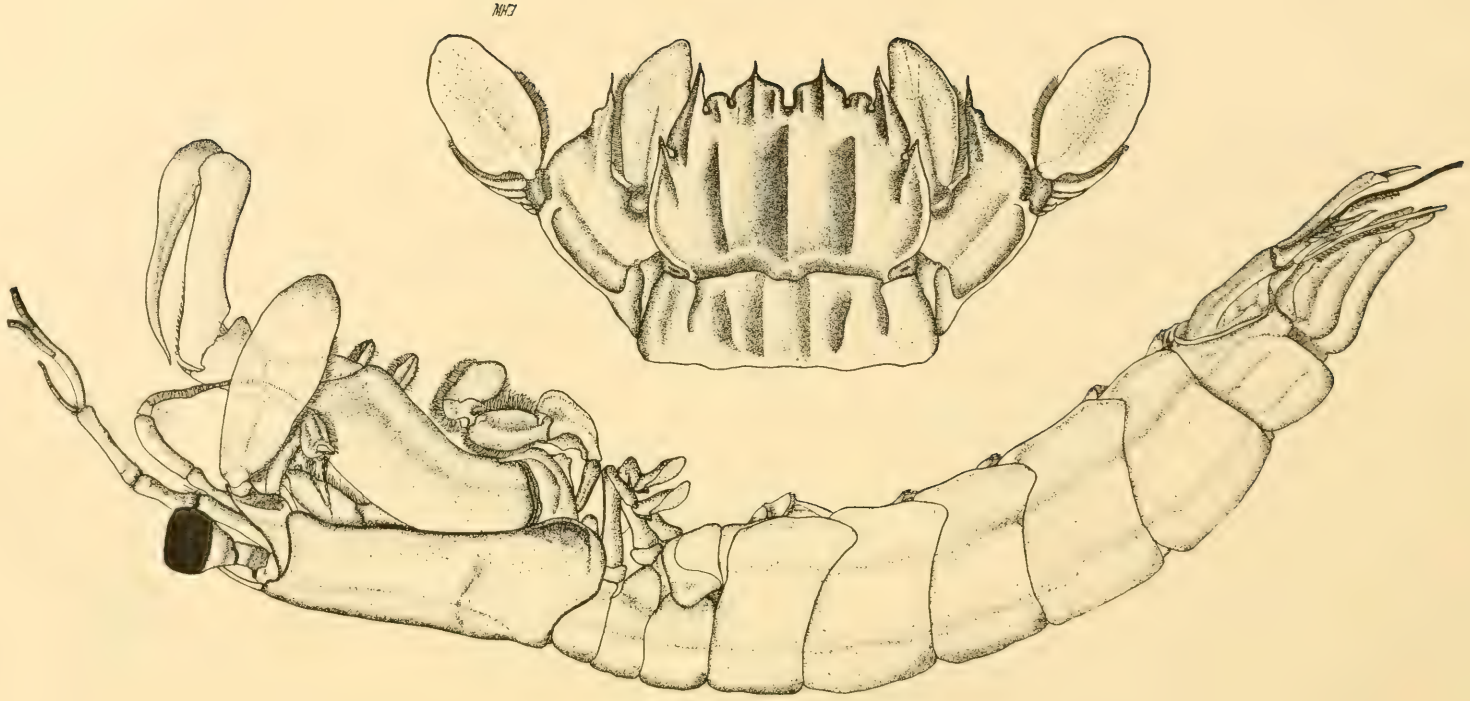
# Pseudosquilla From Laguna

Due to the kindness of the United States National Museum, the squilla-like crustacean obtained off shore from Laguna Beach during the summer of 1914 has been determined to be *Pseudosquilla bigelowi* Rathbun. The drawing of the animal and the drawing of the dorsal view of the caudal end were made by Mr. E. H. Welch, a student in Pomona College.—W. A. H.



# Neuroptera in the Claremont-Laguna Region

## Preliminary List

It is our purpose to publish from time to time lists of animals found in this region. Some will be more or less definite studies in special groups or special distributions. Unless otherwise stated, these lists will be based upon specimens in actual possession of the department. The work of many will be included. Not only the contributions of present and future, but also the extensive collections contributed to the department by Professor Cook and Professor Baker, through a number of years, as well as specimens obtained by Crawford, Metz, Essig and many other special students, as well as material from both Claremont and Laguna Beach which is brought in every year by general classes. For the determination of much of this material we have to thank specialists in all groups all over the country, as well as museums and other institutions.

The purpose of these lists is in part as follows:

(1) To learn what animals occur in this region, for the purpose of later studies both by the college and others.

(2) To let others know what we have.

(3) To have the benefit of criticisms and suggestions concerning the species in these preliminary lists, so that we may be able to detect errors and make new collections in special groups where it seems especially needful.

In no sense are these lists final, and they are necessarily more or less incomplete and far from exhaustive in many cases.

W. A. Hilton.

## NEUROPTERA

Raphidiidæ.

*Raphidia occulta* Bks. Length 12 mm. This species is fairly common about Claremont. Students bring in specimens every year.

*R. californica* Bks. Length 26 mm. This is not so often found.

CHRYSOPIDÆ.

*Chrysopa californica* Coq. This common species is found near Claremont and in the mountains.

*C. rufilabis* Bks. Our only specimen is somewhat smaller than the last.

*C. furculata* Bks.

*Eremochrysa californica* Bks. From the mountains north of Claremont. This has darker wings.

HEMEROBIIDÆ.

*Polystoechotes punctatus* Fabr. Length 30 mm., depth 10 mm. A large, broad-winged species. Many irregular large dark spots on the fore wings.

*Micromus variolosus* Hay. Length 8 mm.

*Sympherobius angustus*. Length 6 mm.

*S. perparvus* McL. Length 5 mm. Our smallest species.

*S. californicus* Bks. Length 6 mm. Found at Laguna Beach.

*Hemerobius pacificus* Bks. Length 10 mm. These have been found at Claremont and Laguna Beach.

*Megalomus latus* Bks. Length 9 mm. The fore wings marked by a triangular dark patch near the center of the wing. There are other dark marks on the wings.

MYRMELEONIDÆ.

*Brachynemurus longipalpus* (?) Hag.

*B. sackeni* Hag. Abdomen marked above by light spots widely separated. From the mountains to Laguna Beach.

*B. Papago* Cur. Thoracic region speckled with dark and light areas. Abdomen with *small* light spots. From Claremont and Laguna.

*Myrmeleon distans* Bks. Clear wings, rather dark body. From Laguna Beach.

*(Contribution from the Zoological Laboratory of Pomona College)*

# Elateridæ (Coleoptera) From the Claremont-Laguna Region

## (Preliminary List)

RAY E. GARDNER

*Plastocerus schaumii* Lec. Length 13 mm., width 3.5 mm. Light yellowish brown. Prothorax quite narrow. Claremont.

*P. schaumii* Lec. Variety. Length 14.5 mm. Somewhat darker brown. Claremont.

*Aplastus speratus* Lec. Length 14 mm., width 3 mm. Elongate sub-convex. Antennæ long. Dark brown, but rows of yellowish hairs give it a lighter appearance.

*Aphricus californicus* Lec. Length 6.5 mm., width 1½ mm. Black, roughly punctate antennæ very long and moderately serrated. Body elongate, showing suture on back; mandibles long and slender. Claremont.

*Euthysonius lautus* Lec. Length 24 mm., width 6 mm. From a red to a dark brown. Elongate, subconvex. Prothorax pointed on each side behind. Antennæ pectinate. Claremont.

*Cardiophorus tenebrasus* Lec. Length 8.6 mm., width 2.5 mm. Body elongate, subconvex, prothorax very convex, body black, legs reddish. Antennæ serrate. Slight covering of greenish hairs. Claremont and mountains near.

*C. ænus* Horn. Length 4 mm., width 1.5 mm. Thorax rounded, shiny. Dark reddish brown elytra slightly lighter than thorax, slightly covered with hair. Antennæ longer than thorax. Claremont.

*C. crinitus* (?) Blanch. Very much like *C. tenebrasus,* only smaller. Length 6.5 mm., width 2 mm. Prothorax broad.

*Ludius lecontei* Horn. Length 25 mm., width 6 mm. Elongate, moderately robust, gradually narrower and tapering behind the middle. Black.

*Elater cordatus* Horn. Length 11 mm., width 3½ mm. Wedge-shaped, elongate, subconvex. Elytra orange or light yellowish

brown, each with large black spot near the tip. Claremont and mountains near.

*Elater cordifer* Lec. 9 mm. by 3 mm. Much like the last mentioned. Mountains near Claremont.

*Megapenthes tartareus* Lec. 10 mm. by 3 mm. Dull black, antennæ long and strongly serrated.

*Dolopius lateralis* Esch. 9 mm. by 2 mm. Light brown on the dorsum; body very narrow; antennæ moniliform, nearly serrated. Body yellow on ventral side. Claremont and mountains near.

*Melanotus longulus* Lec. 9 mm. by 2½ mm. Body black on both sides, covered with many white hairs. Antennæ slightly serrated. Claremont and mountains.

*Limonis vernalis* Fall. 8 mm. by 2 mm. Elytra reddish brown, shining. Mountains near Claremont.

Another lot of the same genus were larger.

*L. californicus* Man. 9 mm. by 2½ mm. Dull brown. Claremont.

*Athous excavatus* Mots. 10 mm. by 3 mm. Dark brown, elytra with marked ridges, prothorax bright reddish, brown stripe either side of the head. Claremont.

*Serocosomus debilis* Lec. Length 5 mm. by 1½ mm. Light brown, head darker.

*(Contribution from the Zoological Laboratory of Pomona College)*

# Chrysomelidæ (Coeoptera) in the Claremont-Laguna Region
## (Preliminary List)

RALPH P. JAMES

*Haltica carinata* Germ. Small, 4 mm. by 2 mm. Purplish-copper colored. Claremont.

*Crepidodera cucumeris* Horn. 2 mm. by 1 mm. Grayish brown. Claremont.

*Systena tæniata* Say. 3.5 mm. by 1.5 mm. Grayish yellow. Narrow brown stripe down center of elytrum and broader stripe along inner margin.

*Glyptina cerina* Lec. 2 mm. by 1 mm. Reddish-yellow. Pomona.

*G. atriventris* Horn. Slightly smaller than the above, deeper shade.

*Phyllotreta lewisii* Cr. 2 mm. by 1 mm. Shining black. Mountains near Claremont.

*Odontota californica* Horn. 4 mm. by 1.5 mm. Rather square cornered body, light brown, fine ridges running longitudinally on elytra, head and prothorax small. Mountains near Claremont.

*Cassida texana* Cr. 5 mm. by 3.5 mm. Oval, dull green, fine irregular gray or black markings; fine ridges on elytra; flattened at margin all about. Claremont and mountains.

*Psylliodes punctulata* Mels. 3 mm. by 1 mm. Shining coppery black. Laguna Beach.

*Longitarsus livens* Lec. 2.1 mm. by 1 mm. Grayish brown; rather egg-shaped. Laguna Beach.

*Luperodes torquatus* Lec. 4 mm. by 1.3 mm. Prothorax red, elytra emerald green. Mountains near Claremont.

*Gastroidea cæsia* Rog. 5 mm. by 2 mm. Purplish green. Claremont.

*Diabrotica soror* Lec. 6 mm. by 4 mm. Pear shaped; greenish-yellow elytra with twelve irregular black dots. Claremont.

*D. trivittata* Mann. 5.5 mm. by 2.2 mm. Elongate yellowish gray elytra with dark brown stripe down middle and along each inner edge; reddish-yellow thorax, black head. Laguna Beach.

*Trishabda flavolimbata* Mann. 9 mm. by 3½ mm. Rather pear-shaped. Bluish-green elytra with gray border on outer edge. Laguna Beach.

*Monoxia* sp. 3 mm. by 1.5 mm. Grayish brown. Claremont.

*Loma trivittata* var (?). 7 mm. by 3.5 mm. Shining brown with black stripes down middle of each elytron and along inner edge.

*Coscinoptera æneipennis* Lec. 6 mm. by 3 mm. Thick prothorax gray, with coppery elytra dark. Mountains near Claremont.

*Saxinis saucia* Lec. 5 mm. by 3 mm. Grayish blue body, metallic blue prothorax and elytra, red spot on shoulder of each elytra. Claremont and mountains near.

*Exema conspersa* Mann. 2 mm. by 1.2 mm. Rough, brownish-black, almost cylindrical. Claremont.

*Cryptocephalus sanguinidollis* Saffr. 4 mm. by 2.5 mm. Shining black elytra and head, prothorax black. Claremont and mountains near.

*C. spurcus* Lec. 4.5 mm. by 3 mm. Brownish yellow with three narrow darker brown stripes down each elytron. Claremont and mountains near.

*Pachybrachys punctatus* Bowd. 4 mm. by 2 mm. Yellowish brown elytra, square head. Laguna Beach.

*Glyptoscelis squamulatus* Cr. 8 mm. by 4 mm. Gray, faint lighter straps down elytra. Slight silvery appearance. Laguna Beach and Claremont.

*Chrysochus cobaltinus* Lec. 10 mm. by 6 mm. Brilliant metallic purplish blue. Claremont.

*Colaspidea varicolor* Cr. 3½ mm. by 2 mm. Coppery metallic luster. Claremont.

*(Contribution from the Zoological Laboratory of Pomona College)*

# Preliminary List of Common Heteroptera From the Claremont-Laguna Region

R. A. LA FOLLETTE

The following is a list of species from some of the common families of Heteroptera found in this region. A short description of colors is given where it will aid in distinguishing the species.

PENTATOMIDÆ

*Euchistus impictiventris* Stal.

Dark brown (Fig. 1), 11½ mm. by 6½ mm. broadest part. Claremont and Mts. near.

*Thyanta perditor* Fab.

9 mm. by 6 mm. Bright green shoulders, sharp pointed. Claremont.

*T. custator* Fab.

11 mm. by 6 mm. Bright green with reddish band from shoulder to shoulder in most cases. (Fig. 2.)

*Banasa dimidiata* Say

9 mm. by 5 mm. Olive brown, head brick red. Mts. near Claremont.

*Prionosoma podopioides* Uhl.

9 mm. by 5 mm. Golden brown, hairs on head, antennæ and about edge of body, caudal half of body serrated. Catalina Island and Mts. near Claremont.

*Cosmopepla conspicillaris* Dal.

7 mm. by 4 mm. (Fig. 3.) Black with red band from shoulder to shoulder. Scutellum tipped with red. Red rim about the body. Claremont and Mts. near.

*Eysarcoris intergressus* Uhl.

5 mm. by 4 mm. Color golden copper. (Fig. 4.) Mts. near Claremont.

*Murgantia histrionica* Hahn

10 mm. by 7 mm. Black with red spots. (Fig. 5.)

*Brochymena quadripustulata* Fab.

(Fig. 6.) Brown. Claremont and Laguna.

*Neottiglossa carifrons* Stal.

6 mm. by 3 mm. Gray touched with black. Claremont. (Fig. 7.)

*N. undata* Say

6 mm. by 3 mm. Gray and black. Claremont.

*Peribilus limbolarius* Stal.

7 mm. by 5 mm. Brown scutellum tipped with yellow. Claremont.

LYGÆIDÆ

*Lygæus melanocoryphus bicrucis* Say

8 mm. by 3 mm. Red with yellow border. Claremont.

*L. turcicus* Say

11 mm. by 4 mm. Red and black with two white spots on the wings. (Fig. 10.) Claremont and Laguna.

*L. protensis* Linn.

6 mm. by 3 mm. Laguna.

*L. sallei* Stal.

5 mm. by 2 mm. Light brown, wings prominent. Laguna.

*Oncopeltus faciotus* Dal.

Orange and black. Claremont.

*Hyoidea grisca* Uhl.

4 mm. by 2 mm. Small. Light dirty green. Claremont.

*Chlrochroa* sp.

Green. Laguna.

COREIDÆ

*Chelinidea vittigera* Uhl.

13 mm. by 5 mm. Golden copper, with gold stripes down center of head. Light yellow veins on the wing bright yellow. (Fig. 12.) Claremont.

*Catorhintha texana* Stal.

12 mm. by 4 mm. Copper brown color. (Fig. 13.) Claremont.

*Marqus inconspicuus* H. S.

Claremont.

*Aufeius impressicollis* Stal.

6 mm. by 2½ mm. Gray with dark spots about edges of wings. (Fig. 14.)

*Harmostes fraterculus* Dist.

7½ mm. by 3 mm. Distinct old gold. Scutellum short and pointed. Claremont.

*H. reflexulus* Say

7 mm. by 2½ mm. Light brown on dorsal side, scutellum and edge of wing yellow. (Fig. 15.) Claremont.

*Niesthrea lateralis* var. *roseus* Baker

5 mm. by 2 mm. Color very light greenish yellow, brownish on wing covers. Prominent eyes. Claremont and Mts. near.

*N. sidæ* var. *scutatus* Stal.

7 mm. by 2½ mm. Old gold color, wings heavily veined. Claremont.

*N. s.* var. *validus* Uhl.

Light golden yellow, hairy, brown spots on fore part of forewings. Margin of body yellow with brown spots. Claremont.

*Corizus scutatus* Stal.

7 mm. by 3 mm. Dark brown faintly spotted with gray. Spots about edge of wing.

*Seventha trivittata* Say

Claremont. (Fig. 16.)

SCUTELLERIDÆ

*Homomeus proteus* Stal.

6 mm. by 4 mm. Light gray brownish spots, head darker. (Fig. 17.) Mts. near Claremont.

*H. grammicus* Wolff

5 mm. by 3 mm. Light brown streaked with darker markings, head darker. (Fig. 18.) Claremont and Mts. near.

*H. bijugis* Uhl.

6 mm. by 4 mm. Light yellow with light brown streaks running the length of the body. Claremont and Mts.

*Eurygaster cavinatus* Van D.

12 mm. by 7 mm. Dull copper with little specks.

*E. alternatus* Say

9 mm. by 5 mm. Copper red shading off in spots to a light yellowish copper. Small dark spots about edge. Claremont and Laguna.

*Sphyrocoris punctellus* Stal.

Claremont.

REDUVIIDÆ

*Apiomerus flaviventris* H. S.

*A. immundus* Champ. 15 mm. by 5 mm. Black, yellow border; spots of red on legs. (Fig. 21.) Claremont and Laguna.

*Zelus socius* Uhl.

Mts. near Claremont.

*Z. incarnatus* Berg.

Claremont.

*Darbonus productus* Uhl.

Brown. Claremont.

*Conorhinus productus* Uhl.

(Fig. 22.) Claremont.

*Rasahus thoracicus* Stal.

19 mm. by 6 mm. Golden yellow with black and yellow wings. From Mts. to coast.

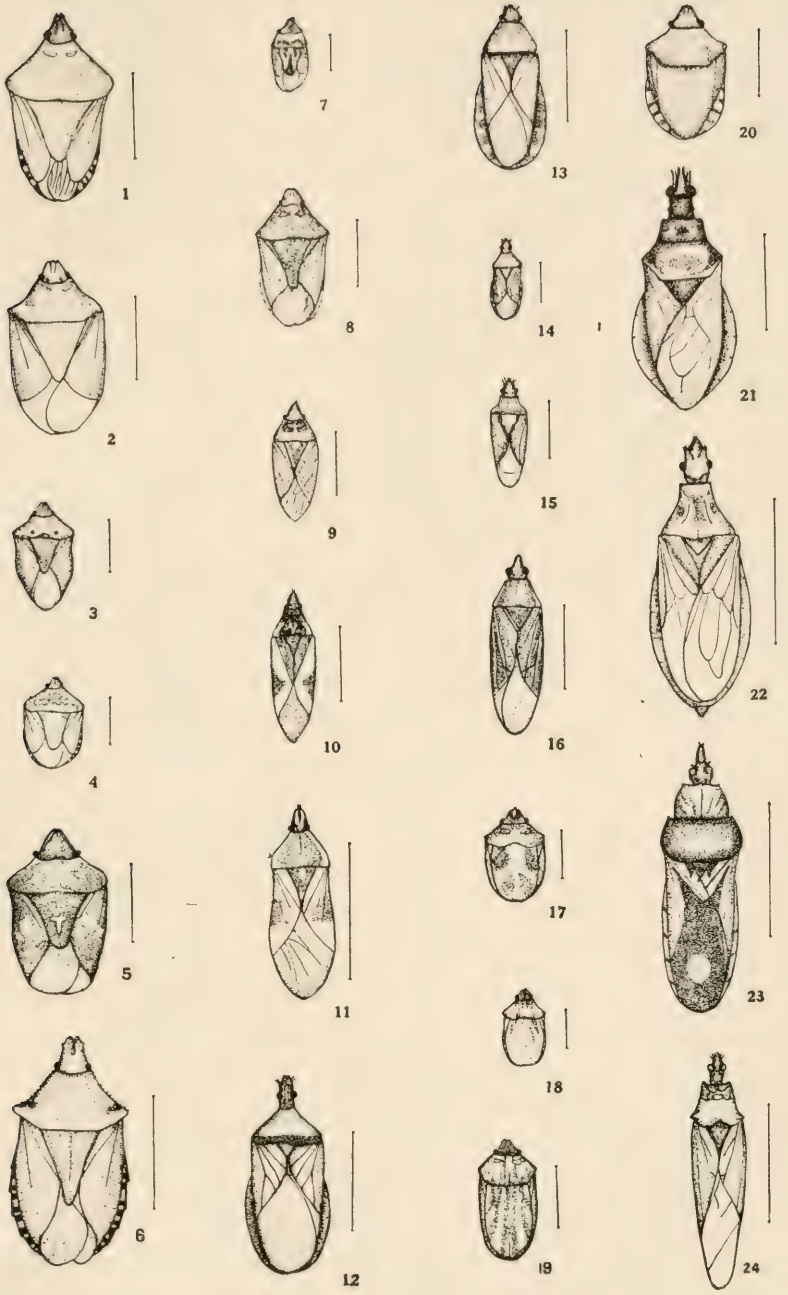
*R. bigultatus* Say

20 mm. by 6 mm.

Claremont and Laguna.

*Rhynocoris ventralis femoralis* V. D.

11 mm. by 3 mm. Body and legs black, wings very light brown. Laguna Beach.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CAPSIDÆ

*Atomoscelis seratus* Bent

2 mm. by 1 mm. Very light green. Claremont and Mts. near.

*Piagiognatharia moerens* Uhl.

5 mm. by 2 mm. Light yellow and black. Claremont.

*Rhinacola forticornis*

3 mm. by 1 mm. Brownish black. Claremont.

*Engytatus simplex* Reut.

1½ mm. by ½ mm. Yellowish white. Claremont and Mts. near.

*Diaphnidia pellicucuida* Uhl.

1 mm. by ½ mm. Wings greenish white, body dirty yellow. Claremont.

*Hyoidea grisea* Reut.

5 mm. by 2 mm. Yellow olive green. Thorax, a few spots of black.

*Dicyphus californicus* Reut.

4½ mm. by 1 mm. Slate blue tinge on wings, body black, wings two prominent brown veins. Mts. near Claremont.

*Hoplomachus consors* Uhl.

4 mm. by 2 mm. Light red, body black, light stripe down thorax and head. Claremont.

*Orthotylus planatus* Uhl.

3 mm. by 1½ mm. Dirty white with greenish tinge. Claremont.

*Poscilocapsus lineatus* Fab.

7 mm. by 3 mm. Spotted black and yellow, red head. Claremont.

*Pœciloscytus elegans* Reut.

4 mm. by 2 mm. Black and yellow, red spot on wing covers. Mts. near Claremont.

*Systratiotas brounneosus* Uhl.

6 mm. by 3 mm. Light brown with brick red scutellum and red edges to wings. Mts. near Claremont.

*Trachycoris socius* Uhl.

Greenish black. Claremont and Mts.

*Irbisia politus* Uhl.

5 mm. by 3 mm. Very dark olive green, legs yellowish brown. Claremont and Mts. near.

*Phytocoris roseus* Uhl.

5½ mm. by 2 mm. Very light red. Claremont.

*P. cunescens* Reut.

4 mm. by 2 mm. Grayish white to dark gray. Claremont.

*P. bakeri* Reut.

5 mm. by 2 mm. Light gray. Claremont and Mts. near.

TINGIDIDÆ

*Teleonemia nigrina* Uhl.

3½ mm. by 1½ mm. Light brown. Claremont.

*Corythuca setosa* Cham.

4 mm. by 3 mm. Brown center. Claremont.

*(Contribution from the Zoological Laboratory of Pomona College)*

1914 Pomona College Journal of Entomology and Zoology, Vol. VI, No. 4, Dec.

# Studies in the Comparative Size of the Red Blood Corpuscles of Birds

CHI TSAU WANG

The blood corpuscles of a large number of vertebrates were studied at Laguna Beach during the past summer. Some of the sizes of cell and nucleus are given below. The blood was obtained as fresh as possible; in no case was the blood obtained longer than twenty-four hours after death. The corpuscles were measured by the ocular micrometer and checked by the aid of a camera lucida.

| Common Name | Scientific Name | Average Size of Corpuscle Microns | | Average Size of Nucleus Microns | |
|---|---|---|---|---|---|
| | | Length | Breadth | Length | Breadth |
| Western Gull | Larus occidentalis | 14.70 | 8.82 | 6.53 | 3.27 |
| Heermann Gull | Larus heermanni | 14.05 | 7.84 | 6.21 | 2.77 |
| Great Blue Heron | Ardea herodias | 13.72 | 8.82 | 6.53 | 3.27 |
| Red-breasted Merganser | Mergus serrator | 13.07 | 7.51 | 6.86 | 2.77 |
| Arkansas Kingbird | Tyrannus verticalis | 12.77 | 9.47 | 5.55 | 3.10 |
| California Road Runner | Geococcyx californianus | 12.09 | 9.15 | 5.27 | 3.27 |
| Long-billed Dowitcher | Macrorhamphus griseus scolopaceus | 12.41 | 8.49 | 5.24 | 2.46 |
| Least Tern | Sterna antillarum | 11.76 | 8.46 | 6.21 | 2.94 |
| Semipalmated Plover | Aegialitis semipalmata | 11.43 | 6.21 | 5.24 | 2.77 |
| Arizona Hooded Oriole | Icterus cucullatus nelsoni | 11.27 | 8.49 | 4.41 | 2.94 |
| San Diego Song Sparrow | Melospiza melodia cooperi | 10.94 | 8.33 | 5.27 | 2.53 |
| Least Vireo | Vireo pusillus pusillus | 10.45 | 9.47 | 5.55 | 2.77 |
| California Woodpecker | Melanerpes formicivorus bairdi | 10.45 | 6.53 | 5.24 | 2.77 |
| Belding Marsh Sparrow | Passerculus beldingi | 10.08 | 6.86 | 4.90 | 2.77 |
| Willow Gold Finch | Astragalinus tristis salicamans | 9.80 | 6.79 | 6.04 | 2.94 |
| California Horned Lark | Otocoris alpestris actia | 9.47 | 6.21 | 4.25 | 2.12 |
| Western Lark Sparrow | Chondestes grammacus strigatus | 8.49 | 5.55 | 5.24 | 3.10 |

*(Contribution from the Zoological Laboratory of Pomona College.)*

# Amphibia of the Claremont-Laguna Region
## (Preliminary List)

Three species of Urodela have been found in this region.

*Batrachoseps attenuatus* Esch. This very slender species has been found more widely distributed than any other in this region. It is most easily found during wet years. Individuals have been collected during the past two years from well up in the mountains in Cow canyon, one of the branches of the San Gabriel. They have been found abundantly in and about Claremont. Some were collected on top of the highest hills near Laguna, as well as in one of the smaller canyons less than a mile from the sea. A number of specimens were also obtained from Catalina Island.

*Autodax lugubris* Hallow. So far this species, or animals resembling it, have been obtained from the mountains. It has not been found abundantly. Only some of the lower canyons which are rather rocky have furnished specimens, such as Stoddard's and Cucamonga.

*Diemyctylus torosus* Esch. This large aquatic salamander is found in many of the larger canyons and in water which flows from mountain streams. We have found it most abundantly in San Dimas, Cucamonga, Live Oak, Big Dalton and Palmer's. It probably occurs in many others.

We have but five species of Anura so far:

*Bufo halophilus* Baird. Common in all the region from the mountains to the sea.

*Hyla arenicolor* Cope. Gray or brown spotted or blotched or unspotted. Found in the canyons.

*Hyla regalla* Baird and Girard. These little frogs, gray, brown, green or red are probably found in all the region. They have been found breeding this year in February among the hills near Pomona. They were found very abundantly among the tall vegetation about the lakes near Laguna Beach.

*Rana pretriosa* Baird and Girard. This frog is found in most of the larger streams in the mountains.

*Rana draytonii* Baird and Girard. One specimen of this large frog was brought in from San Dimas canyon in 1914.

*(Contribution from the Zoological Laboratory of Pomona College)*

# Record of Two Fish, Not Before Mentioned, from Laguna

During the summer of 1914 no special effort was made to collect fish, but the two following species were taken:

*Porichthys notatus* Girard

A specimen of this interesting but rather common Californian fish was taken in a tide pool and kept for some time alive in the aquarium. This is sometimes called "Midshipman," because of the bright metallic spots over the head and body, like the buttons on a midshipman's uniform of years ago. These spots are provided with a lens, connective tissue capsule and a reflector, and are supposed to be luminous.

*Mola mola* Linnæus

A small specimen of this head-fish, or sunfish, was brought to us by the fisherman. W. A. H.

# Additional Notes on the Birds of Laguna Beach

LEON L. GARDNER

In accordance with the general plan of the Laguna Marine Laboratory, a part of the work was with the birds of the locality.

As mentioned in the First Annual Report of the Laboratory, Laguna Lakes, about four miles up Laguna Canyon; Balboa, eight miles up the coast, and the surrounding rocky wild hills of Laguna, afford rich and varied collecting. Perhaps the richest area of bird life lies between Laguna and Balboa, in the Irvine Ranch. This is a large tract of land comprising many thousands of acres, extending about seven miles up the coast from Laguna and eleven miles inland. The canyons here are steep and, in some localities, very wooded in contrast to the more open canyons farther down the coast. For years this land has been given over to cattle grazing, and the Irvine company, in order to safeguard the stock, have allowed no one, except their own range riders, to enter the property. In the years 1911 and 1912 this was a state game preserve, and there is considerable rumor among local residents that it was stocked with some kind of pheasants. However, I have neither seen nor heard of a specimen taken. In all events, the protection afforded the birds has been taken advantage of, and quail, road-runners, many species of hawks and all of the smaller birds thrive in abundance and safety.

The fifteen days of collecting were spent largely in covering as large an area as possible, to obtain the widest range of representative species, with field notes, etc., to be placed in the Laboratory building, as a nucleus for greater collections and for the benefit of the local residents or summer visitors who are interested in the work of the College.

The additions to the first list, published in the First Annual Report, as mentioned before, are as follows:

*Gavia immer* (Brünnich) Common Loon

A specimen taken in Balboa Bay, July 6, 1914. This is rather an unusual record, as the Loon is only a winter visitant; however,

some are known to remain throughout the summer. Mr. Swarth tells me that this specimen had lost the power of flight during its molt. He thinks this seems to indicate that Loons lose the ability to fly during molting, as do the Anseres.

*Gavia pacifica* (Lawrence.) Pacific Loon

June 27, I found a dead Pacific Loon cast up on the beach. The specimen was in very worn and oddly colored plumage. On examination Mr. Swarth said it was a partial albino and had skipped a regular molt.

*Larus heermanni* Cassin. Heermann Gull

Abundant about the Bay at Balboa.

*Mergus serrator* Linn. Red-breasted Merganser

A female taken July 6, 1914. This is a very late record for this bird, since it leaves mostly in April. It was found resting on a sand spit in Balboa Bay.

*Oidemia perspicillata* (Linn.) Surf Scoter

Common along the coast from Laguna to Balboa.

*Oidemia deglandi* Bonaparte. White-winged Scoter

Occurring with the preceding species.

*Erismatura jamaicensis* (Gmelin). Ruddy Duck

Occurring at the tule lake in Laguna Canyon.

*Himantopus mexicanus* (Müller). Black-necked Stilt

One taken at Laguna Lakes, now mounted and in possession of J. N. Isch, Laguna Beach.

*Macrorhamphus griseus scolopaceus* (Say)
Long-billed Dowitcher

A specimen taken on the sand spits in Balboa Bay, July 6, 1914. This appears to be an early fall migration record.

*Catoptrophorus semipalmatus inornatus* (Brewster)
Western Willet.

Abundant in August, less common in July. Often in company with Hudsonian curlews (*Numenius hudsonicus*) along the coast. One taken as early as July 6.

*Heteractitis incanus* (Gmelin). Wandering Tattler

Found in August along the rocky coast by Arch Beach (down the coast from Laguna).

*Actitis macularius* (Linn). Spotted Sandpiper

Common along the beach in August.

*Ægialitis semipalmata* (Bonaparte). Semipalmated Plover

A small flock found at Balboa July 13.

*Ægialitis novisa* Cassin. Snowy Plover

One taken between Laguna and Balboa.

*Buteo borealis calurus* Cassin. Western Red-tail

Fairly common in the hills. There seemed to be several different species of hawks at Laguna, but as they were very shy and most of them took refuge in the forbidden territory of the Irvine Ranch, none of the larger ones were obtained.

*Haliaeetus leucocephalus leucocephalus* (Linn.) Bald Eagle.

There are five Bald Eagles that are commonly seen along the beach near Laguna. When followed, they are always found to come to rest on the high, rocky west slope of Aliso Canyon (down the coast from Laguna). The owner of the canyon, Mr. Joe Thurston, tells me that for years a pair has bred there, and these other three are young that did not leave the vicinity. He is very jealous of their safety, and it is to be hoped they may always be kept there as a natural attraction. This is one of the few breeding points along the coast from which the Bald Eagle has not been driven. In March, 1895, Mr. E. Davis took two fresh eggs of the Bald Eagle near Laguna Beach. It would be very interesting to know whether or not he obtained them from the same canyon; if so, this must be a very old breeding place.

*Pandion haliaëtus carolinensis* (Gmelin). Osprey

One shot from a flagstaff in the center of town. The date is uncertain, but appears to be about 1905. The specimen is now mounted and in the possession of Mr. J. N. Isch of Laguna.

*Otus asio bendirei* (Brewster). California Screech Owl

Fairly common in the timbered canyons.

*Speotyto cunicularia hypogaea* (Bonaparte). Burrowing Owl

Common in upper Aliso Canyon, which is more open and very hot and arid.

*Ceryle alcyon* (Linn.) Belted Kingfisher

I noted two birds which were undoubtedly of this species along a rocky stretch of the coast, but was unable to collect one.

*Melanerpes formicivorus bairdi* Ridgway. California Woodpecker

I obtained two specimens of this species from a flock in Nigger Canyon. This seems to be a very low altitude at which to find these birds.

*Myiochanes richardsoni richardsoni* (Swainson).
Western Wood Pewee

I collected two of this species in the willow bottoms July 25, 1912, which seems to be an indication that they are summer residents.

*Corvus corax sinuatus* Wagler. Raven

Irregular along the coast. One collected July 19.

*Astraglinus tristis salicamans* (Grinnell). Willow Goldfinch

Common in the willow bottoms.

*Ammodramus savannarum bimaculatus* Swainson
Western Grasshopper Sparrow

Very common in one particular grassy glade at the top of the ridge around Laguna, also at the tule lakes. I took a young bird June 27, which seems to indicate the birds were breeding there. This is one of the few breeding records for Southern California.

*Hirundo erythrogastra* Boddaert. Barn Swallow

Common along the rocky cliffs; some breeding in July.

This concludes the additional list. There is one other breeding record worthy of note. In Nigger Canyon (Irvine Ranch) there is a Great Blue Heron nesting colony. Although such colonies were at one time common along the coast, they are now becoming rare. The colony is situated in a large clump of sycamore trees, in the bottom of the canyon, some half mile or more inland. There are about thirty nests, quite white with bird lime; the trees and ground also are well covered, showing the permanency of the site. On June 26, 1914, I visited the colony and found very young birds, but

no eggs. The whole place was filled with a peculiar stench, while the croakings of the old birds, coupled with the frightened squawks of the young, and the invisible, choking powder down, made the place quite undesirable. The old birds were very bold, but not pugnacious, and while the examination of the nests went on retired to nearby trees to watch the proceedings, while the young crowded out to the uttermost branches, keeping up a continual racket.

Owing to the protection afforded by the Irvine ranch, the colony has thrived and probably will for an indefinite period.

*(Contribution from the Zoological Laboratory of Pomona College.)*